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SIR SHANTI SWARUPA BHATNAGAR

SIR S. S. BHATNAGAR, Director, Scientific and Industrial Research, Government of India, whose sixtieth birthday on February 21 was celebrated by scientific and learned societies all over the country, occupies indeed a unique position in the field of Indian science. As Prime Minister Nehru observed on a recent occasion, the gigantic programme of building the National Laboratories would never have gone as far ahead as it has but for the drive and enthusiasm of Bhatnagar. It may be said that he has been in no small measure responsible for the status to which science in India has attained in recent years.

The record of his career both as a scientific investigator and later as organiser of large-scale scientific research is rather enviable. In 1919, he went to England and worked under Prof. F. G. Donnan. He also worked at the Sorbonne, Paris and the Kaiser Wilhelm Institute, Berlin, for sometime. He returned to India as Professor of Chemistry at Banares Hindu University where in a short time he created an active school of physical chemistry. In 1924,

Bhatnagar was invited to join the Punjab University as University Professor of Physical Chemistry and Director, University Chemical Laboratories at Lahore. His sixteen years' stay there was characterised by intensive activities in the domain of research. In 1926, he switched over to magneto-chemistry, a field in which he and his pupils may be considered as pioneers. In collaboration with R. N. Mathur, he devised a magnetic interference balance which was manufactured by Adam Hilgers.

His scientific work has won him many honours. In 1943, the Society of Chemical Industry elected him an Honorary Fellow and later as Vice-President. The same year, he was elected a Fellow of the Royal Society. He is a past President of Indian Science Congress and the National Institute of Sciences of India.

It was only in the fitness of things that Bhatnagar was invited to function as Director of Scientific and Industrial Research when the war broke out. In spite of heavy administrative and advisory duties, Bhatnagar found time to take a personal interest in research work and

several processes of great importance were worked out by him and his staff. Included amongst these are anti-gas cloth and varnish, air-foam solution, vegetable oil blends as lubricants and fuels, unburstable containers, glass substitutes, dehydrated castor oil, plastics from Indian wastes and others.

Originally a war-time assignment, the activities of the organisation which he then set up have since been geared to the harnessing of science to the promotion of national welfare. The Government of India has now a Ministry of Natural Resources and Scientific Research, of which he is the Secretary. Amongst the new developments which have been initiated at his instance, in addition to the well-known instances of the National Laboratories, are the establishment of Indian Rare Earths Limited, to process monazite sands, intensification of the search for atomic minerals and sulphur-bearing ores.

The National Laboratories which may with every justice be regarded as the handy work of Bhatnagar represent a symbol of the kind of progress to be expected in a country which has already made valuable contributions in several branches of science. They can vie with the best of their compeers in any part of the world.

Bhatnagar has devoted considerable attention to the practical utilisation of the results of

scientific research, which have culminated in the establishment of a National Research Development Corporation.

Amongst other achievements, the following owe their initiation more or less to Bhatnagar's imagination and drive: the scheme of foreign scholarships for higher studies in technical subjects, exemption for expenditure on research from income-tax, Indian Standards Institution, Regional Polytechnics, to mention only a few.

A born administrator, he is always in close touch with every branch of activity under his care. Quick decisions and a tacit faith in his lieutenants are characteristics which have contributed considerably to the successful discharge by him of any assignment. The establishment of oil refineries in India is in a great measure the result of his persuasive influence and skill as a negotiator.

As Sir Robert Robinson has observed, it is indeed fortunate that India found at a critical time in her history an eminent scientist of clear vision, sound judgement in affairs and boundless energy in action. His high office has enabled him to realise wisely ambitious plans and today are to be seen the concrete results, a dream come true and one which lies especially closest to his heart.

Our heartiest felicitations to Sir S. S. Bhatnagar on this memorable occasion.

USE OF ATOMIC ENERGY FOR PEACEFUL PURPOSES

THE peaceful uses of atomic energy in developing electric power and the uses of atomic rays in medicine, agriculture and industry, are the subject of a 16-page feature in the December issue of the *UNESCO Courier*. The possibilities for the future development of countries that lack coal, for the use of atomic rays in the treatment of disease and of artificial radioactive materials in the improvement of food production, the maintenance of health and the efficiency of industry are so great that they are fully discussed in a series of articles intended primarily for the school teachers of the world and through them to the school children of the world.

The *Courier* gives a complete but simple story of the ABC of nuclear physics and includes the story of the natural rays from such materials as radium, cosmic rays, the uses of the great

cyclotron and the many scientific discoveries that have come from the use of artificial radioactive materials. There is also an article on the European Organization for Nuclear Research, through which 12 European nations will combine their resources to enable young European scientists to keep up with this new science.

As the editorial of the *Courier* states, "The frontiers of man's knowledge are now within the atom.... The scientific facts and principles explained are truly an expansion of man's universe. As the great explorers mapped the earth, and the astronomers of to-day chart the sky, so the atomic scientist, delving into matter and energy, has discovered an unknown world that is a revelation for philosophers and a vast resource for future generations. No educated person can afford to ignore these facts."

NEW ORGANIC REMAINS FROM THE VINDHYAN SYSTEM AND THE
PROBABLE SYSTEMATIC POSITION OF *FERMORIA*, CHAPMAN

M. R. SAHNI AND R. N. SHRIVASTAVA

Geological Survey of India

THE material upon which the following study is based was collected in 1950 by the senior author from the Vindhyan strata of Neemuch District, Central India. The main object of the study was to find evidence concerning the true phylogenetic relationship of the genus *Fermoria*, a problem that has so far baffled palaeontologists and palaeobotanists alike. Evidence is now forthcoming which appears to prove the algal nature of the genus. In addition, a new genus which we propose to name *Krishnania*, probably related to *Fermoria*, is described. We also examined, in peel sections, some material already collected by Jones from near Rampura, Neemuch District. The peel sections likewise suggest the plant nature of the genus *Fermoria*.

F. Chapman¹ (1935), examined these carbonaceous discs in detail and identified them as true brachiopods. He created the genera *Fermoria* and *Protobolleta* for their inclusion and tentatively assigned them to the order *Atrēmata*.

A chemical test on these carbonaceous bodies was made by C. Ampt for the detection of ammonia, in order to ascertain the presence of chitinous substance. Although the test for ammonia was positive, it could not be ascertained, beyond doubt, whether this came from the fossil or the shale itself, which also gave a very strong reaction for ammonia. The nature of the test, therefore, remained inconclusive.

In the same year (1935), M. R. Sahni² re-

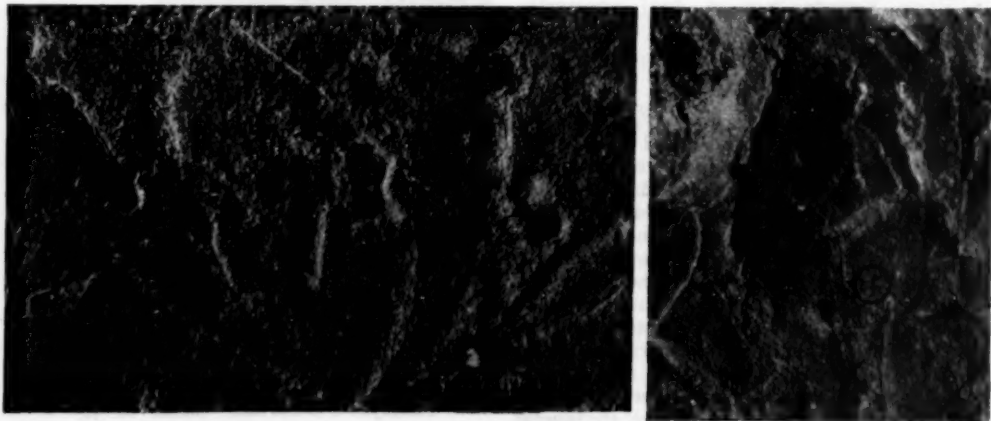


FIG. 1. *Fermoria* attached to apparently convergent filaments ($\times 2$).

FIG. 2. Filament showing the funnel-shaped end (*f*) with *Fermoria* at the other extremity ($\times 2$).

Much controversy has centred around the nature of these discoidal remains. In 1909, H. C. Jones,¹ expressed the view that these fossils might belong to the genus *Obolella* or *Chuaria circularis* described by Walcott, from the Pre-Cambrian of Arizona, or that they might possibly be the operculum of *Hyalithellus*. In 1927, C. D. Walcott and G. E. Resser² thought that these fossils were definitely brachiopods, closely related to the Cambrian genus *Acrothele*. Later, in 1928, B. F. Howell³ tried incineration tests and tentatively assigned them to the blue green algae, comparable to Walcott's genus *Morania*, of Cambrian age.

He revised Chapman's type material at the request of Sir L. L. Fermor, then Director, Geological Survey of India. He came to the conclusion that these fossils did not exhibit any character which would enable their assignment to the brachiopoda, there being no evidence whatsoever of a pedicle apex or growth lines, as suggested by Chapman. He placed these fossils under a new family, the *Fermodiidae*.

In 1950, R. C. Misra⁶ tentatively suggested that these fossils may be the remains of Ostracods. Recently, Misra⁷ (1952) has modified his opinion about the nature of these disc-like bodies. On the strength of incineration tests

and the great variability of their size and shape. He regards them as simple mineral encrustations. He further supports their inorganic origin by the observation that they increase in size with the increasing coarseness of the embedding shale, thereby implying that it was progressively easier for mineral matter to be injected into coarser rocks.

In view of the divergence of opinion, a detailed examination of some of the material collected in 1950 was undertaken. While the vast majority of the *Fermoria*-bearing slabs showed isolated specimens of normal type, though of varying size, we were fortunate to discover examples of discs intimately associated with broad filaments. There is little doubt that the discs and the filaments are in organic union with each other. In nearly all cases, a single filament is seen associated with a single disc. However, in one case, the orientation of the filaments is very suggestive of a composite individual, about ten filaments (each terminating in a single *Fermoria*-type of disc) apparently tending to converge on to a single point (Fig. 1). No actual union of the filaments is, however, noticed in the direction of convergence.

The best preserved specimen (Fig. 2) shows a filament about 1.85 cm. long and 3 mm. wide. (These dimensions appear to represent the average of the filaments observed.) The filament widens appreciably towards one end where it becomes funnel-shaped and is 6 mm. across. The other end terminates in a small disc about 3 mm. in diameter. The disc is in some cases smaller than the width of the filament and thus gives the impression of being embedded in the filament, rather than being terminal in character. These discs are identical with *Fermoria* in shape and general character and are suggestive of spores. There are several other examples which exhibit the same funnel-shaped termination. To the left of the specimen shown in Fig. 2 may be seen three specimens of *Fermoria* in juxtaposition with each other, and of graded size. It is, however, uncertain whether the graded, chain-like arrangement is natural or a mere coincidence. The latter alternative appears to be more plausible.

Although several filaments have been examined, none of them show any trace of septa. Nor has any other cell structure been observed. The general characters of the fossils indicate that we are dealing with plants, possibly algae. Another interesting structure has been observed in peel sections which also appears to indicate that the discs to which the name *Fer-*

moria has been given, are spherical bodies and that the so-called growth-lines (which are not truly concentric as sometimes claimed) are in fact relatively thicker tissue to serve as reinforcement and give strength and rigidity to the spore. Careful observation has shown that these reinforcing tissues converge on to at least two points on the disc (Fig. 3). Obviously only one side of the disc can be properly examined.

The suggestion by R. C. Misra that *Fermoria* represents inorganic encrustations appears to be controverted by the fact that discs of varying size occur in the same slab, irrespective of the coarseness of the grain of the rock. These are obviously individuals at different stages of growth.

Chemical tests are being carried out by Mr. P. D. Malhotra, in the Laboratory of the Geological Survey of India, and a fuller report will follow.

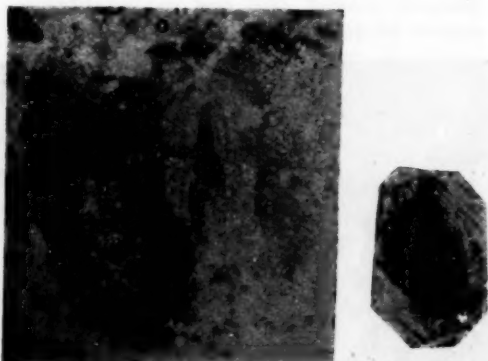


FIG. 3. Peel section of *Fermoria* showing reinforcement tissue ($\times 20$).

FIG. 4. *Krishnantha acuminata*, gen. et sp. nov. Genoholotype (G. S. I.) ($\times 2$).

Family? *Fermoriidae*, Sahni, M. R.
Krishnantha acuminata, Gen. et sp. nov.

There is a well preserved specimen (Fig. 4) and another partly preserved one in the fossil collection under investigation which undoubtedly represents a new genus, and probably belongs to the *Fermoriidae*, Sahni.

Diagnosis.—The fossil is acuminate ovate in shape. Its longest axis measures 7.5 mm., its maximum width being 4 mm. It narrows somewhat abruptly at one end, but is evenly rounded at the other. In general outline, therefore, it bears a resemblance to *Lingula*, but the similarity is superficial and no relationship is implied. A characteristic feature of the genus is a deep, marginal furrow, more prominent on one side (probably due only to better preserva-

tion here) and apparently continuous all round. In places, there appears to be a fine subsidiary elevation within the furrow, which thus becomes divided into two.

The general shape, large size and sharp acuminations separates this genus from *Fermoria*. The marginal furrows, too, are distinct from the

lines seen in the peripheral portion of *Fermoria*, to which reference has been made above.

1. *Rec. Geol. Surv. Ind.*, 1909, **38**, 66.
2. *Ibid.*, 1927, **60**, 18.
3. *Ibid.*, 1928, **61**, 21-22.
4. *Ibid.*, 1935, **69**, Pt. 1, 109-20.
5. *Ibid.*, 1935, **69**, Pt. 4, 458-68.
6. *Micropalaeontologist*, 1952, **6**, No. 1.
7. *Sci. and Cult.*, 1952, **18**, 46.

SLIDES FOR PROJECTION

DURING the celebration of the session of the Indian Science Congress at Hyderabad, the members of the Botany Section were often shown tables and diagrams through the epidiascope; this method of projecting such tables is commonly accepted as a good substitute for the rather expensive one of preparing slides by photography, but in general the method leaves much to be desired, even when the epidiascope is in perfect condition; the text or table is not properly centered, or is upside-down, or the paper original curls up and goes partly out of focus, etc.

To obviate these difficulties the present author has been using a few methods for many years, which are given below in the hope they may be of use to others as well.

(1) *Tables with Text or Numbers.*—Take a sheet of cellophane paper such as is used for wrapping cigarette or sweet packets; the paper should be even, without folds or creases. (In the Bombay market, and possibly elsewhere, the paper is available in sheets about 2-4 times the size of foolscap, and costs only 4-8 annas per sheet.) Next, take a sheet of fresh carbon paper, and fold it through the middle so that the carbon surfaces are inside and touch each other. Place a sheet of cellophane paper of convenient size in between the two folds of the carbon paper, and place the whole in the typewriter; remove the ribbon, as is done in the case of waxed sheets for the cyclostyle. Type directly on to the carbon paper, taking care that the text does not go beyond the size of the slides. The result is a clean typed sheet that will project with great luminosity. Place this sheet of cellophane between two slides and insert into the projection machine.

(2) *Diagrams in one or more colours.*—There are available in the market a number of inks that can write directly on any clean sheet of glass. I have used for years "Gold Seal Laboratory Ink", with very satisfactory results. With these inks it is possible to write directly on glass which has not been prepared in any way other than a thorough cleaning. There are several colours of these inks, so that rather complicated and artistic slides can be prepared with them. After writing on the glass, allow the ink to dry properly, and project as soon as necessary. The glass slides can be handled safely, as the ink hardens to almost the consistency of the glass itself.

Where such special inks are not available, Indian ink can be used with almost similar results; but in this case the glass slide has to be prepared to receive the Indian ink. There are several methods of preparing the glass: in photographic shops one often finds a good solution that serves very well. Canada balsam diluted thinly with xylol also serves the purpose: smear the slide with the solution and allow to dry completely; if the slide is placed in an oven at 50 or 60°C. for about 3 hours, the slide is generally ready and dry. If Canada balsam is not readily available, smear the white of the egg on the glass surface, and allow to dry. The slide is ready to receive writing with Indian ink, provided its surface is properly dried before Indian ink is applied to it.

H. SANTAPAU.

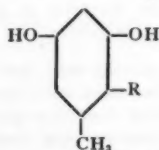
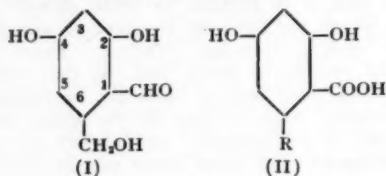
St. Xavier's College,
Bombay

THE OCCURRENCE OF C_8 -UNIT IN NATURAL PRODUCTS

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Dept. of Chemistry, University of Delhi, Delhi

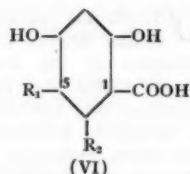
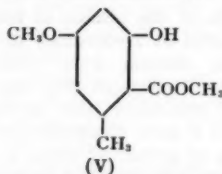
THE origin of the C_8 -unit (orsellinic unit) (I) and the various modifications it can undergo were made the basis of a theory of biogenesis of depsides and depsidones widely occurring in lichens.¹ Four of the derived units were originally recognised (II a, $R = CH_3$), (II b, $R = CH_2OH$), (II c, $R = CHO$) and (II d, $R = COOH$); other variations (III and IV) seem also to exist, e.g., orsellinaldehyde (III) has been recognised to constitute a unit in pannarin.² Later modifications involving nuclear methylation, nuclear oxidation and depside and depsidone formation following accepted rules of organic chemistry explain the evolution of all known members.

III, $R = CHO$, IV, $R = CH_3$

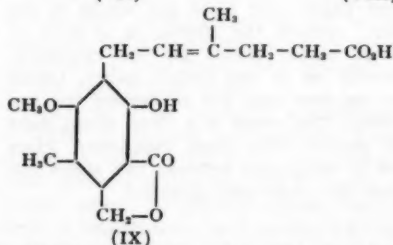
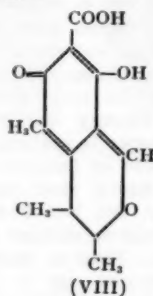
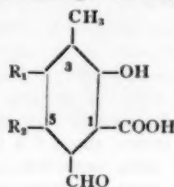
A large number of compounds found in lichens also occur in moulds, e.g., erythritol, β -carotene, ergosterol, polyporic acid, physcion, endocrocin and thelephoric acid. Further there is close structural similarity between a number of mould products and lichen substances. Consequently various features in the evolution of compounds of the two groups may be expected to be more generally common and the C_8 -unit expected to be present in the mould products also. This is supported by a careful examination of structures of compounds belonging to different categories. However there is this difference that decarboxylation and nuclear reduction are found to occur more widely in the evolution of mould products. For the present purpose they are considered under four categories.

(1) BENZENE DERIVATIVES: These number more than twenty. Sparassol (V) and dihydroxy phthalic acid (II d) (DHP) are obviously simple derivatives of the C_8 -unit. The three ketones

(VI a, $R_1 = H$, $R_2 = CHO.H.CH_2.CH_3$), (VI b, $R_1 = H$, $R_2 = CHO.H.CO.CH_3$) and (VI c, $R_1 = H$, $R_2 = CO.CO.CH_3$) occurring in *Penicillium brevi compactum*³ exhibit chain lengthening of the alkyl group in the 6-position, a feature noted in the case of lichen acids also. An extra step of nuclear oxidation in the 5-position is found in ustic acid (VI d, $R_1 = OCH_3$, $R_2 = CHO.H.CO.CH_3$).



β -Orcinol derivatives of lichen acids have an alkyl group in the 3-position, whereas in mould products both the 3- and 5-positions carry side chains in various states of oxidation. Cyclopolic and cyclopaidic acids (VII a, $R_1 = OH$, $R_2 = CH_2OH$ and VII b, $R_1 = OH$, $R_2 = CHO$) are the simplest examples; in the evolution of citrinin (VIII) and mycophenolic acid (IX) further changes are involved.

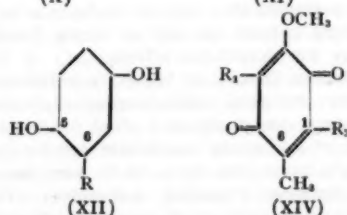
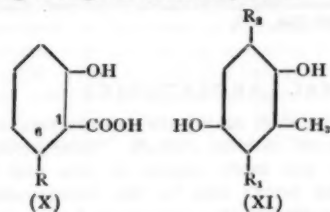


6-Methyl salicylic acid (Xa, $R = CH_3$) and mellein (Xb, $R = CHO.H.CH_2.CH_3$) are products of nuclear reduction in the 4-position of the

earlier orsellinic systems. Actually it is quite easy to prepare the former in the laboratory starting from orsellinic acid. As belonging to this group could be mentioned gladiolic and dihydro gladiolic acids (VII c, R₁ = H, R₂ = CH₂OH and VII d, R₁ = H, R₂ = CHO). Flavo-

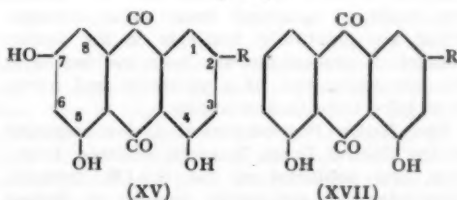
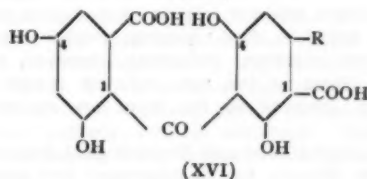
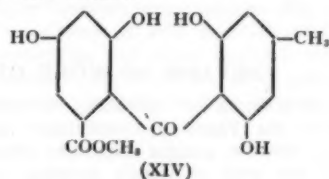
glauclin (XI a, R₁ = C₆H₁₅, R₂ = CO.CH = C(CH₃)₂) and auroglauclin (XI b, R₁ = (CH = CH)₃, CH₃ R₂ = CO.CH = C(CH₃)₂) are also two related

toluquinols coming under this category but having other modifying features. From these types gentisyl alcohol (XII a, R = CH₂OH) and gentisic acid (XII b, R = COOH) can be derived by using a stage of decarboxylation.



(2) QUINONE DERIVATIVES: Quinones occur usually in association with quinols and obviously constitute oxidation-reduction systems. Many of them contain C-methyl groups and seem to be capable of derivation from the orsellinic unit. As important intermediates may be mentioned 3- and 5-hydroxy orsellinic acids whose evolution by nuclear oxidation has already been discussed.⁴ Fumigatin (XIII a, R₁ = OH, R₂ = H) could be developed from 3-hydroxy orsellinic acid through stages involving oxidation and decarboxylation. From fumigatin to spinulosin (XIII b, R₁ = R₂ = OH) is an easy stage involving para-nuclear oxidation and to 4-methoxy toluquinone (XIII c, R₁ = R₂ = H) is a stage of nuclear reduction. Aurantiogliocladin (XIII d, R₁ = OCH₃, R₂ = CH₃) would represent an example in which the group in the 1-position has undergone reduction to a methyl; it has the derived orsellinic unit (IV).

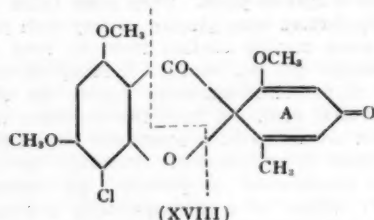
(3) ANTHRAQUINONE DERIVATIVES: Among mould products, the anthraquinone derivatives occupy a special place. They seem to be very readily formed from glucose in very high yields and some moulds contain them in very high percentage (30 per cent.). A study of lichen and mould anthraquinones leaves no doubt about their evolution from two orsellinic units. Almost invariably DHP constitutes one of them, the other being variable. Probably the simplest combination is provided by sulochrin (XIV) which is a benzophenone derivative. Compounds of the frangula emodin group (having 2-methyl as well as 2-hydroxymethyl groups) (XV) should be evolved by the nuclear reduction of the second unit of the intermediate (XVI) and subsequent anthraquinone ring closure.



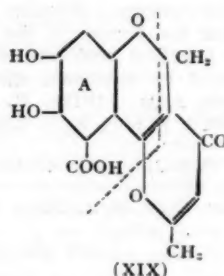
Chrysophanol derivatives (XVII) differ from the above in having no hydroxyl groups in 7-position. Though they are thus simpler in structure, they should be considered to involve more stages in evolution. They are the result of nuclear reduction in both the concerned orsellinic units in the 4-position. Rhodocladonic acid and solorinic acid are obviously β-orscinol derivatives.

(4) MIXED TYPES: There are other compounds which could be classed under mixed types having only one orsellinic unit, the other component being different. Under this category come grisefulvin (XVIII) and citromyctin (XIX).

In the formula of these compounds the orsellinic units are indicated as (A).



The wide occurrence of the orsellinic unit (C_8 -unit) in lichen and mould products is thus established. It should be considered to be as important as other well known units already fully recognised to be present in natural products.



1. Seshadri, *Proc. Ind. Acad. Sci.*, 1944, **20A**, 1.
2. Yosioaka, *J. Pharm. Soc. Japan*, 1941, **61**, 332.
3. Oxford and Ralstrick, *Biochem. J.*, 1932, **26**, 1902; 1933, **27**, 634 and 1473.
4. Aghoramurthy and Seshadri, *Proc. Ind. Acad. Sci.*, 1952, **35A**, 327.

REVIEW OF WORK OF THE NATIONAL LABORATORIES

THE programme of industrial development, which the Planning Commission has laid down for 1951-56, assigns important responsibilities to the work of India's National Laboratories, where research is being carried on in such varied fields as food, housing, roads, metals, glass and ceramics, industrial chemicals and others. Some of the less technical results of research achieved so far there are reviewed below:—

The Central Food and Technological Research Institute, Mysore, has demonstrated that starch can easily be prepared from mango kernels, which are plentifully available in the Indian villages. A process has also been evolved by it for the preparation of a palatable and nutritious juice from cashew apples.

The *Indian Pharmaceutical Codex* compiled by the Central Drugs Research Institute, Lucknow, and published by the C.S.I.R. recently, constitutes an exhaustive survey of Indian drugs of vegetable and animal origin. Incidentally, the publication also provides India with her first national pharmacopoeia.

Investigations at the Central Building Research Institute, Roorkee, have shown that coal ash, discharged from the boilers, can, after suitable treatment, be used for making cement mixes. About 10-12 per cent. of portland cement can thus be replaced by the ash and the resulting mixture used in making mortars and concrete.

The Central Glass and Ceramic Research Institute, Calcutta, has produced good quality sand-lime bricks from lime sludge obtained as

a waste product during the manufacture of acetylene from calcium carbide. These bricks are stronger and more regular in size and shape than clay bricks and by the incorporation of various pigments they can be made in a variety of pleasing colours for use as facing bricks in buildings for decorative effects.

The Indian Bureau of Mines, in collaboration with the National Metallurgical Laboratory, Jamshedpur, has designed a plant for the beneficiation of low grade manganese ore for industrial units producing from 10-15 tons per day.

The National Chemical Laboratory, Poona, has evolved a method of preparing phosphatic fertiliser by the action of hydrochloric acid on phosphate rocks from Egypt and phosphatic nodules from Tiruchirapalli. The hydrochloric acid needed can be obtained from chlorine, large amounts of which are produced as a by-product by the Indian alkali plants.

The problem of sulphur has also engaged the attention of the Fuel Research Institute, Jeelgora, which has located a valuable source. Research by the Institute shows that Nowrozabad coal contains pyrites which can be recovered without any extra expense in the normal washery treatment of the coal, and sulphur can be obtained from the pyrites. On the basis of 150 tons of coal washed per hour for 20 hours a day, about 50 tons of pyrites will be available which can yield about 25 tons of sulphur every day.

The Central Electro-Chemical Research Institute, Karaikudi, is now engaged in the work of developing processes for recovering aluminium

from scrap arising from aluminium ware and utensils' manufacture and from used and discarded aluminium vessels. The Institute has also made progress in preliminary experiments on the fabrication of special primary batteries characterised by many useful features such as high current and power output, prolonged cell life, lightness and wide operation range.

The most important tanning material used by the Indian leather industry is wattle bark and for this, the country is dependent on outside supplies. Intensive research by the Central Leather Research Institute, Madras, has located an efficient substitute in Karada bark.

In addition to advanced fundamental research, the National Physical Laboratory, New Delhi, has also been engaged in industrial research. It has evolved an improved gas carburettor of the automatic type capable of operating in conjunction with petrol carburettor but having independent control. A digester suitable for production of bone meal for use as fertilisers has also been designed in the Laboratory. The

Central Road Research Institute, New Delhi, is engaged in studies on road materials and construction techniques which will yield better roads at lower cost. The Institute is directing attention to the improvement of locally-made bricks for metalling rural roads by increasing their compressive strength and decreasing the formation of dust, which occurs through wearing of the brick metal.

To fill the gap between research and its industrial application, the Government has established a National Research Development Corporation. The main function of the Corporation is to exploit in the public interest inventions of the Council of Scientific and Industrial Research and its National Laboratories, inventions of other State-owned Research Institutes and of other research organisations like Commodity Committees. It will also afford facilities to universities and other research institutions, and where public interest so demands, to individuals also, to exploit their inventions.

ANTIBIOTICS

IN the course of a lecture delivered at the Indian Institute of Science, Bangalore, Professor E. B. Chain of Oxford traced the growth of antibiotics from the time that he and his group of workers demonstrated in 1940 that a mould product containing the active principle designated penicillin from *P. notatum* possessed remarkable curative properties. The strain was by no means new, having been isolated by Alexander Fleming earlier.

Professor Chain recalled how after preparing a somewhat purified product from the culture fluid he injected some 30 mg. into a mouse and expected it to die. The greatest surprise was that it did not, and the experience was unforgettable. After the animal experiments, there were some dramatic cases of cure in hospital patients. These initial successes with penicillin inaugurated a new era in chemotherapy.

The chemical formula of penicillin proposed by Chain and Abraham was not initially accepted by any one. But elaborate studies with the aid of the X-ray diffraction patterns, Fourier analysis and interatomic distance measurements made later have only confirmed the original formula. The substance contains two amino acids, but wherefrom their wonderful properties are derived is not clear.

Attempts have been made recently to prepare biosynthetic penicillins by using different acids and constituents in the culture media.

The products behave in the same manner. Lately, a new type of penicillin, 'Cephalosporin', has been reported. It is different from penicillin, in that it gives α -amino-adipic acid on hydrolysis, is also very active against gram negative bacteria, and is non-toxic. Further work on this is being watched with great interest.

Reviewing the work on other antibiotics, Professor Chain observed that Waksman had studied the properties of streptomycin isolated from cultures of *S. griseus* in great detail. In some cases of typhoid, it was found to be highly useful *in vitro*, but not *in vivo*. Pellmann of Mayo Clinic showed in a classical work that the antibiotic is effective against acute forms of tuberculosis. In most of the pulmonary cases, however, it produces resistant strains after two or three administrations. Prof. Chain also dealt at length with the phenomena of synergism in the action of antibiotics. A combination of penicillin and streptomycin has proved efficacious, while aureomycin with penicillin did not prove advantageous. Aureomycin and terramycin were instances of agents which had proved active against some viruses. It would appear that more antibiotics are needed urgently for the treatment of pulmonary tuberculosis and the virus diseases. Further advances will no doubt depend on fundamental progress in the field of chemical microbiology.

N. R. SRINIVASAN.

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PITCHSTONE FLOW IN RAJMAHAL HILLS, BIHAR

In his letter published recently in *Current Science*, Raja Rao¹ records the existence of a pitchstone flow amongst the basaltic lava flows of the Rajmahal Hills. He is under the impression that this is the first recorded occurrence of a pitchstone flow in India.

Nevertheless, in my paper² on the "Lavas of Pavagad Hill" many years ago, I have described a specimen of pitchstone collected from this hill, broken from a loose block high up the mountain. On Pavagad Hill are seen flows of rhyolite, specimens of some of which are described in the paper, and there seems little doubt that the pitchstone described by me must have come from one of these acid flows.

It is of considerable interest that the basaltic

flows of Rajmahal and of the Deccan Trap should both have had rhyolitic interludes. The microscopic details of the Rajmahal and Pavagad pitchstone sound similar. The specific gravity of my pitchstone is 2.54 as compared with the Rajmahal range of 2.400-2.538.

Also we must not overlook that Fedden as long ago as 1884, recorded the occurrence of trachy-felsites, pitchstone and obsidian in Kathiawar (*loc. cit.*, p. 169, and *Mem. Geol. Surv. Ind.*, XXI, pp. 96-98, the last page for a "bed of pitchstone").

Gondwana,
Horsell, Surrey, England,
December 23, 1953.

LEWIS L. FERMOR.

1. Raja Rao, C. S., *Curr. Sci.*, 1953, 22, 330.

2. Fermor, Lewis L., *Proc. Geol. Surv. Ind.*, 1906, 34, 153.

A NEW METHOD OF INTEGRATING SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS

A NEW method which is in many ways superior to the existing ones, has been discovered for constructing solutions of second order linear differential equations, which may find considerable application in many branches of applied mathematics.

The process consists first in converting the given equation in the normal form,

$$\frac{d^2y}{dt^2} + f(t)y = 0 \quad (1)$$

and then guessing an n th order approximate solution which fits in with the boundary value conditions of the problems. Let this solution be y_n . The $(n+1)$ th order approximation will then be

$$y_{(n+1)} = y_n \cdot y_n^{-1/2} \exp -\frac{1}{2} \int \frac{f(t)y_n}{y_n} dt, \quad (2)$$

where

$$y_n' = \frac{dy_n}{dt}$$

This process may be repeated indefinitely, and a solution of equation (1) may be obtained to any desired degree of accuracy.

It can easily be shown that if the above process is convergent, the limit, as n increases actually satisfies the equation (1).

The author wishes to thank Sir J. C. Ghosh, for his interest, and to Dr. G. Bandopadhyaya, for helpful criticisms.

Dep't. of Applied Chem., RANAJIT SEN GUPTA.
Indian Institute of Technology,
Kharagpur, November 22, 1953.

FLUCTUATIONS OF TEMPERATURE NEAR THE GROUND

THIS note gives a brief outline of the method adopted in recording the fluctuations of temperature near the ground. These fluctuations arise as a result of turbulence in the lower layers of the atmosphere and they are strongly correlated with the gradient of temperature and vanish as the gradient becomes small. The layer in which these fluctuations exist is explained as the 'Shimmering layer' by L. A. Ramdas¹ and an attempt has been made by the present worker to measure the fluctuations of temperature in the air layers near the ground. These fluctuations are recorded with the aid of a quick-run photographic recorder made by Messrs. P. J. Kipp and Zonen of Holland. The temperature is recorded with the aid of a 40 S.W.G. copper constantan thermo-

couple connected to a sensitive Moll galvanometer of period 1/5 of a second.

W. Hande² and many other workers took measurements of these fluctuations in temperature close the ground by using either platinum resistance thermometers or thermistors. P. K. Raman³ has also recorded these fluctuations using copper constantan thermocouples but the method adopted by the present worker is slightly different. A thermocouple made of 40 S.W.G. copper constantan wires is coated with a thin

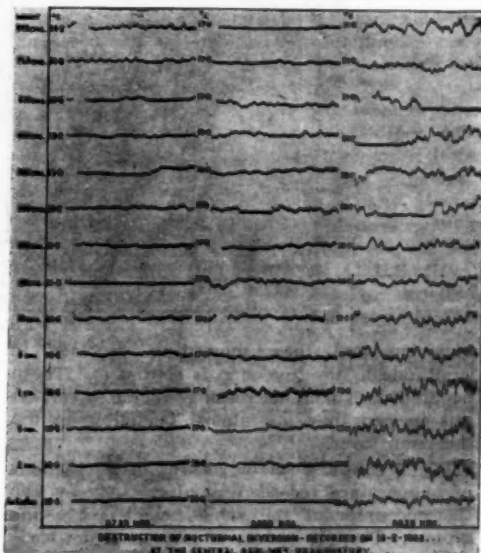


FIG. 1

layer of magnesium oxide to eliminate the radiation effects to the maximum extent possible. This thermocouple is connected in series with a sensitive Moll galvanometer of period 1/5 of a second. The deflections in the galvanometer are recorded by means of a photographic recorder. Using this technique, the characteristics of these fluctuations and their variation with height above the ground as well as with the time of the day are studied. These features have been briefly discussed by L. A. Ramdas³ in a recent paper.

Fig. 1 shows a set of records taken during the destruction of nocturnal inversion on 13-2-1953. The mean temperatures in °C. at the corresponding heights are also marked. The records indicate the way in which the amplitude of these fluctuations increase with time as the inversion is destroyed. Similarly, a set of records were taken during the development of nocturnal

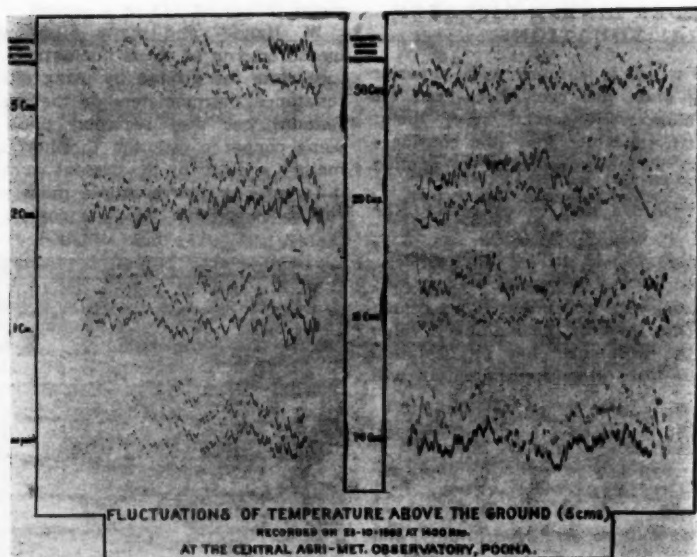


FIG. 2

inversion and they showed a decrease in amplitude as the inversion is setting in. These fluctuations go on decreasing as the inversion sets in and they are almost negligible in the inversion layer.

Fig. 2 shows a set of records of fluctuations of temperature recorded simultaneously by two thermocouples at the same height above the ground. Then by means of increasing the horizontal distance between the thermocouples in stages of 1 cm., 2 cm., 5 cm., 7.5 cm., 10 cm., 20 cm. and 50 cm. the fluctuations are recorded and they show that these fluctuations agree almost upto 7.5 cm. separation and beyond that there is a lag in these fluctuations. Further experiments are being conducted to find out the size of the eddies in relation to the nature of the ground. A detailed discussion of these will be published later on.

Grateful thanks are due to Dr. L. A. Ramdas for suggesting the problem and for the necessary guidance given.

Radiation Laboratory, P. KRISHNA RAO.
Meteorological Office,
Poona-5, November 7, 1953.

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FURTHER STUDIES OF SAND MOVEMENT ACROSS WALTAIR BEACH

It has been found by La Fond and Prasada Rao¹ that sand oscillates around mean sea-level, and these short period oscillations in sand level are mainly related to tide range. Further investigations showed that the Beach in addition to undergoing such short-period cyclic changes, also undergoes long period erosion cycles. In the calm months of January and February, the Beach stands higher, while during the months of July and August it retreats. This has been observed at two stations, one near Andhra University (Fig. A) and the other near Scandle Point (Fig. B).

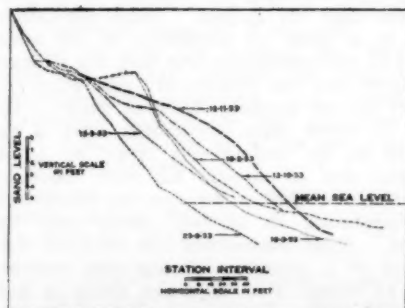


FIG. A. Profiles of beach taken over a number of months near Andhra University.

Apparently the Beach is built during the period following September and October and the fill attains a maximum in February, whereas the Beach begins to retreat from May and attains an equilibrium in August-September. Further, high waves cut the Beach while low waves build it up. High waves not only wash the Beach higher than the low-surf, but also gain speed during the backwash because of the farther movement of the 'Swash', extending up to the backshore (Figs. A and B), thus taking much of the sand from the foreshore and backshore.

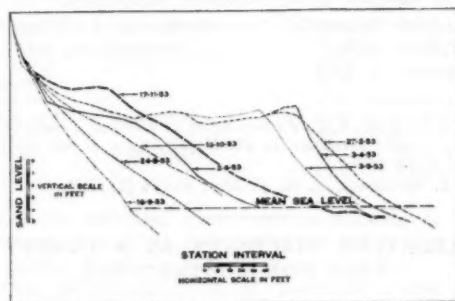


FIG. B. Profiles of beach taken over a number of months near Scandle Point.

TABLE I
Monthly average wave height

January	1' 3"	June	3' 0"
February	<1'	July	2' 9"
March	1' 11"	August	2' 10"
April	1' 8"	September	1' 9"
May	3' 1"	October	2' 1"

Between January and April when the height of the waves is quite low (Table I), the Beach is built, while during the months following May the Beach is cut by high waves. Also the rise in sea-level is partly responsible for the Beach retreat. The sea-level is very low during January and February² (when the Beach stands higher) and rises during the months following May. Sea-level is an important factor because the changes are considerable and it has been reported² that the Bay of Bengal has the greatest annual cycle of sea-level of any place in the world.

Another probable reason for the cutting of the Beach during the months following April may be due to the stopping of the dredging operations and the obstruction of sand movement along the coast by the break-water built across the harbour channel.

It has been observed that Beach 'B' which is full of submerged rocks is cut more swiftly and the cut is more pronounced than in 'A' which is a sandy Beach free from all obstructions. This may be attributed to increased turbulence when the waves strike the rocks, thus putting more sand into suspension. When the sand is in suspension it can be easily moved by the long-shore currents or on-shore and off-shore circulation. This is especially true in May when the wave energy is greater.

Hence it is believed that the relative change in wave energies utilized in putting sand in suspension in the two seasons is mainly responsible for the difference in the amount of sand eroded in the two Beaches.

It has yet to be investigated whether the eroded sand is deposited in the deeper off-shore area below the low tide level or if it is carried away northwards by the currents. Further studies are in progress.

The author wishes to express his gratitude to Prof. C. Mahadevan for his constant help in the work and to Mr. E. C. La Fond of U.S. Navy Electronics Laboratory, for his constructive criticism and keen interest he has taken in the work.

Dept. of Geology,
Andhra University,
Waltair, December 23, 1953.

R. PRASADA RAO.

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ROTARY CURRENTS

ON several oceanographic cruises conducted by the Faculty and students of the Andhra University in the Bay of Bengal, an unusual surface phenomenon was observed. The water surface was composed of long streaks of alternating smooth and rough water, these streaks in some cases extending to the horizon. They varied in number from two or three to at least ten. Individual streaks varied in width from an estimated 75' to 600'. Their orientation was always parallel to the coast, which is in the direction of the prevailing drift.

On one of these cruises on 13th December, a series of rough and smooth surface streaks was observed near the northern end of the Swath of No Ground at 21° 18.5' N. and 89° 33' E. and off the mouths of Ganges. They were oriented in an east-west direction, and their relative motion with respect to the ship was from north to south. The width of each rough band was

approximately 75' whereas the smooth band was about 100-150'. The surface was rougher on the southern boundary of the rough band.

As the ship drifted across these rough and smooth streaks, repeated bathythermograph (BT) observations in the form of continuous temperature-depth curves on a smoked slide from surface down to around 200' were made. Two such curves were recorded for each observation, one called the "Down Trace" while lowering the instrument and the other, the "Up Trace" while raising the instrument.

It was found that the descending and ascending traces did not coincide with each other but in most cases were widely separated. This is believed to be due largely to differences in position of observation. Therefore the temperatures from both the "Up" and "Down" traces were plotted according to their relative positions under the bands of rough and smooth water. The nature of the trace, whether it is an "Up" trace or a "Down" trace was ascertained by examination with a magnifying glass.

From the resulting vertical temperature structure obtained by the repeated observations and from noting the direction of surface current it is concluded¹ that these long bands of alternately smooth and rough surface water have a rotary motion and are named "Rotary Currents" (Fig. 1). Their flow is in the form

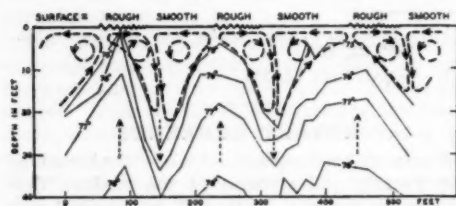


FIG. 1.

of interlocking spirals with their axes in the direction of the prevailing long shore current. This creates lines of convergence where the interlocking surface flows are towards each other and lines of divergence where the flows are away from each other. The vertical thermal gradients produced show deeper layer depths and sharper thermoclines in areas of convergence than in areas of divergence.

Rotary Currents are believed to be developed in the turbulent region where off-shore tidal currents come in contact with the prevailing coastal currents. At the time of BT observations at the afore-mentioned station, the tide was ebbing and setting the ship to the south. It is believed that the diluted estuarine water

flows out on the surface in waves. At the outer boundary of the wave, turbulence exists and with the prevailing east to west flow of the off-shore water, the turbulence is developed into rotary currents.

Rotary Currents have also been observed along the coast for 500 miles to the south. Whether they are developed *in situ* or are the remnants of up-stream features is not known. It is possible that other rivers or shallow coastal areas may also discharge water in gushes normal to the long shore current which develop into new rotary currents.

A detailed paper is under publication.

Andhra University,
Waltair, India,
January 2, 1954.

EUGENE C. LA FOND.
C. BORRESWARA RAO.

1. La Fond, E. C., *Factors Affecting Vertical Temperature Gradients in the Upper Layers of the Sea* (in press).

2. Woodcock, A. H., *J. Mar. Res.*, 5 (3), 196.

RELATIVE VISCOSITY AS A PURITY TEST FOR MUSTARD OIL

It is well known that mustard oil, with the exception of castor oil, is of unusually high viscosity, and that determination of this physical property is useful in detecting adulteration of this oil with other vegetable oils, as a low value would indicate such adulteration.¹ This is of particular value when adulterants, for which no reliable specific tests exist, are present in comparatively small amounts. Examples are niger seed oil, safflower oil, etc. Presence of these as also of other oils lowers the viscosity of pure mustard oil, and inference could be drawn that the mustard oil is not genuine.

There are many varieties of rape and mustard seeds, but for extraction of oil for edible purpose *Brassica napus*, *B. campestris* and *B. juncea* are used commercially in this country.² In the present work most of the samples were extracted from these three varieties, only a few being taramira oil. Of the several methods for determining viscosity each have its particular advantage. In routine analysis where large number of samples have to be examined sometimes simultaneously it was found most convenient to determine the *relative viscosity*, i.e., the viscosity of the oil relative to that of distilled water. The figure was easily arrived at by noting the time of flow of the oil through a capillary and that of water through the same capillary (Ostwald tube was used). Experimental details and calculations are given in

standard text-books.³ The Ostwald capillary tubes were placed in a thermostatic bath and the temperature of determination was 40° C. The oil was filtered through a triple filter prior to the determination.

Results are summarised in Table I.

TABLE I

Relative viscosity of mustard and other common vegetable oils at 40° C.

Type of oil	Relative viscosity
Mustard oil (nearly 100 samples)	60.2 to 63.0
Groundnut (7 samples)	51.0 to 52.0
Cocoanut (average of 2 samples)	34.8
Linseed (" ")	36.0
Safflower (" ")	40.8
Nigerseed (4 samples)	46.2 to 47.4
Castor (")	346 to 357
Sesame (5 samples)	46.0 to 47.6
Olive (4 ")	52.1 to 53.0

Clearly therefore,* if the relative viscosity of mustard oil at 40° C. falls materially below 60.0 its purity should be considered as doubtful.

This determination is of particular value where the usual constants, such as saponification and iodine values, refractometer reading, etc., fail. To quote a typical instance, a sample of pure mustard oil was adulterated with about 15 per cent. of nigerseed oil. Upon analysis, the adulterated oil gave the following figures: Saponification value, 175.4; Iodine value, 105.3; Butyro refractometer reading at 40° C., 60.0; Relative viscosity at 40° C., 58.2.

The slightly higher figures for saponification and iodine values could not be taken as definite evidences of adulteration, because pure mustard oil may at times give such figures. However, a suspicion was raised which was confirmed by the low relative viscosity figure.

In choosing the lower limit for relative viscosity of mustard oil, some allowance will have to be given and a value of 59.0 may be reasonably accepted as the minimum. Figures lower than this should be definitely suggestive of adulteration.

West Bengal Public
Health Laboratory,
Calcutta, October 3, 1953.

S. N. MITRA.
S. C. ROY.

INFLUENCE OF VITAMIN B₁₂ ON THE BIOLOGICAL VALUE OF RAW SOYA BEAN

RECENT investigations have brought out convincingly that vitamin B₁₂ is concerned in transmethylation.¹⁻⁶ In addition to improving protein utilisation, vitamin B₁₂ plays an important role in anabolic processes. Thus, it has been reported that vitamin B₁₂-fed chicks have less non-protein nitrogen and less amino acids in circulating blood than the controls not receiving the vitamin.⁷ This suggests that vitamin B₁₂ contributes to increased feed utilisation. It has also been reported that vitamin B₁₂ enhances the biological value of a poor protein diet⁸ and casein diet.⁹

It was of interest to determine whether the biological value of raw soya bean, which contains growth¹⁰ and proteolytic inhibitors,¹¹ could be improved by supplementing with vitamin B₁₂. Biological value determinations were carried out employing the nitrogen balance method of Mitchell,¹² using cold defatted raw soya bean powder. The endogenous nitrogen excretion was determined by feeding a low protein diet (4 per cent. whole egg protein). The percentage composition of the diet employed was as follows: Osborne and Mendel salt mixture, 4 per cent.; fat (groundnut oil), 10 per cent.; sugar, 10 per cent.; pigment (ferric or chromium oxide), 1 per cent.; cold, defatted soya bean to give 10 per cent. protein; and starch to make 100 per cent. All the vitamins at the usual level were added. There were two groups of rats, each rat weighing about 80 g., grouped on the basis of the usual considerations. One group received the above diet while the other group received the same diet along with vitamin B₁₂ at 50 µg. per kilo of diet. The vitamin was added as a dilute solution to equal to the above concentration every day to the diet.

The biological values obtained with and without the vitamin supplement are 77.6 ± 1.8 and 48.6 ± 0.9 . The results suggest that vitamin B₁₂ has not only helped in greater utilisation of the protein but also overcome the adverse effects of the inhibitors. The exact mechanism of action of the vitamin under these conditions is being studied.

In another study, two groups of albino rats were fed a good stock diet containing 0.25 per cent. iodinated casein for two weeks. After this period they were employed for determining the biological value of the raw soya bean flour, with and without vitamin B₁₂ supplement. The values obtained are, 77.4 ± 1.3 when

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2. *The Wealth of India*, C.S.I.R., Delhi, 1, 212.

3. Senter, G., *Outlines of Physical Chemistry*, 1928, Methuen & Co. Ltd., London, 15th Ed., 82.

supplemented with B_{12} and 66.2 ± 3.1 without the supplementation of B_{12} . Under the conditions existing with the group of rats which received iodinated casein for 2 weeks and where the biological value was determined without vitamin B_{12} supplementation, the metabolism has been highly enhanced with a concomitant increase in the biological value.

In the above studies the amino acids excreted in the urine were also determined quantitatively using the circular paper chromatographic technique of Giri and Rao.¹³ It was found that the concentrations of amino acids in urine per gram of protein intake was much higher in the case of the animals not receiving vitamin B_{12} , thereby lending further support to the view that vitamin B_{12} increases the utilisation of protein.

Further work on the release of certain amino acids consequent on adding vitamin B_{12} to raw soya bean flour is in progress. The detailed paper will be published elsewhere.

Our thanks are due to Professor K. V. Giri for his keen interest in the investigation.

Dept. of Biochemistry,

B. R. BALIGA.

Indian Inst. of Sci.,

R. RAJAGOPALAN.

Bangalore-3, October 21, 1953.

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13. Giri, K. V. and Rao, N. A. N., *J. Ind. Inst. Sci.*, 1952, **34**, 95.

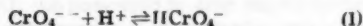
STUDY OF THE ACTION OF ACID ON CHROMATE ION BY GLASS ELECTRODE

SOLUTIONS of chromic acid and chromates have been investigated by a large number of workers. The pH of a dilute aqueous solution of potassium chromate is above 8. Hydroxyl ions are produced due to the reaction $CrO_4^{2-} + H_2O \rightleftharpoons HCrO_4^- + OH^-$. The pH of a dilute solution of potassium dichromate is less than 5. This low pH is due to the reactions $Cr_2O_7^{2-} + H_2O \rightleftharpoons 2HCrO_4^- \rightleftharpoons 2CrO_4^{2-} + 2H^+$. These reactions have been

studied by Brown and Cranston¹ by measuring the change in hydrogen-ion concentration on dilution of solutions of potassium chromate and dichromate. Neuse and Riemann² have studied the latter reactions by measuring the activity of hydrogen ion (by glass electrode) in the solutions of potassium chromate and dichromate mixed in various proportions. These reactions have also been studied by other methods.³ Britton had studied⁴ the reaction I by titrating chromic acid solution against standard alkali using hydrogen and oxygen electrodes.

In the present work, the change in the concentration of hydrogen ion on addition of known amount of acid to a known amount of potassium chromate solution was studied. Standard solutions of potassium chromate (0.09932 M), nitric acid (0.05845 N) and sulphuric acid (0.04794 N) were used. Ammonium nitrate solution (2 M) was prepared from a G. R. sample. 10 ml. of potassium chromate solution were mixed with 50 ml. of ammonium nitrate and a known amount of acid was added. The resulting solution was diluted to 100 ml. The pH of the solution was measured by a Marconi pH meter. Experiments were not done above pH 6 as no arrangement could be made to eliminate atmospheric carbon dioxide. The readings are confined to the pH range 4.5-6.

Chromate ion reacts with hydrogen ion as follows:



Hence addition of an acid does not increase the concentration of hydrogen ion appreciably. Practically the whole of the acid is consumed as if neutralised by a base. The ionic strength of the solutions would be governed by the ionic strength of ammonium nitrate which is in large excess compared to other ionic species. It can therefore be assumed that ionic strength is constant. Let C_1 , C_2 , C_3 and C_H be the molar concentrations of chromate ion, hydro chromate ion, dichromate ion and hydrogen ion respectively and C the g. mol. of potassium chromate in 10 ml. of the solution used and C_A the g. equivalent of acid added. Then

$$\frac{C_1}{C_1 + C_H} = K_1 \quad (1)$$

$$\frac{C_2}{C_2^2} = K_2 \quad (2)$$

$$C = C_1 + C_2 + 2C_3 \quad (3)$$

Change in pH is very small and hence we can assume that the whole of the acid added is neutralised by reaction I.

$$C - C_A = C_1 \quad (4)$$

$$C_A = C - C_1 = C_2 + 2C_3 \quad (5)$$

Since C and C_A are known, C_1 can be calculated by eq. (4). The determination of C_2 and C_3 is not possible directly. It is assumed that when C_2 is small C_3 will be very small and C_A would be very nearly equal to C_2 . But for other values C_A would always be greater than C_2 . In the equation

$$\frac{C_A}{C_1 \times C_2} = K_1' \quad (6)$$

K_1' is always greater than K_1 and it is expected that K_1' would approach the value of K_1 when C_2 approaches zero, i.e., when $C_1 = C$. K_1' values are calculated and plotted against C_1 . The value of K_1' at $C_1 = C$ is taken as K_1 . C_2 is then calculated from eq. (1), and C_3 by eq. (5). K_2 is then found from eq. (2). The values of K_1 and K_2 obtained by using nitric and sulphuric acids are given in Table I.

TABLE I

Temperature °C.	Acid	Extrapolated $K_1 \times 10^{-5}$	Mean value of $K_2 \times 10^{-2}$
32	HNO ₃	5.43	1.71
32	H ₂ SO ₄	4.68	3.54

It is interesting to note that the values of K_1 and specially K_2 are a little different in the two cases. The reaction of dichromate ion with acid is under investigation.

The details will be published elsewhere.

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SEPARATION OF GLUCOSE AND SORBITOL BY PAPER CHROMATOGRAPHY

In the course of an investigation of electrolytic reduction of glucose to sorbitol, we had occasion to apply paper chromatography for the detection of sorbitol.

The following systems were tried using Whatman No. 1 filter-paper with ascending runs for 16-20 hours.

- (1) Ethyl acetate-acetic acid-water 3:1:3.
- (2) n-Butanol-acetic acid-water 4:1:4.
- (3) n-Butanol-pyridine-water 1:1:1.
- (4) m-Cresol-phenol-water 4:2:1.
- (5) m-Cresol-phenol-water 2:2:1.
- (6) Phenol-water 4:1.

In the first three systems, the R_f values of glucose and sorbitol were found to be nearly the same, as were also found by Bradfield and Flood,¹ Buchanan, Dekker and Long,² and therefore no separation was possible. In the last three systems, however, there was definite separation, and the R_f values obtained are as follows:

System	R_f Sorbitol	R_f Glucose
m-Cresol-phenol-water 4:2:1	0.24±0.01	0.16±0.01
m-Cresol-phenol-water 2:2:1	0.31±0.01	0.22±0.01
Phenol-water 4:1	0.52±0.02	0.41±0.02

For the detection of sorbitol spots the spray reagent containing bromocresol purple as recommended by Bradfield and Flood (*loc. cit.*) has the disadvantage that the whole of the filter-paper turns green after some time and the spots fade out; hence a new spray reagent was searched for, and the following reagent was found to be satisfactory. 33.3 ml. of 0.1 M boric acid + 26.7 ml. of 0.1 M NaOH + 40 ml. of methyl red indicator (0.02 per cent. in 60 per cent. ethanol).

The chromatograms after developing were dried over a hot plate for 3-4 minutes to expel the phenols and sprayed with the reagent and dried in a similar manner. Sorbitol gave red spots immediately on spraying, while those due to glucose were obtained after some time. The red spots on a yellow background keep well and do not fade out at least for a few days.

Further work with polyhydric alcohols and carbohydrates is in progress. Full details will be published elsewhere.

Our thanks are due to Dr. C. S. Patel for his keen interest and helpful suggestions, and to Miss S. R. Parkhi for the help rendered during this work.

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TRANSFRUCTOSIDASE FROM AGAVE VERA CRUZ

It has been previously reported from these laboratories that the stem juice of *Agave vera cruz* contains polyfructosans, besides a number of simpler sugars as the minor constituents.¹ Observations on an enzyme present in this plant material which mediates in the building of

fructose polymers from sucrose are reported here.

On incubating the stem juice, as also the juice from the unopened primary leaf emerging centrally from the stem, with sucrose as the added substrate, it was repeatedly observed that the optical rotation of the reaction mixture (initially dextro-rotatory due to excess sucrose) progressively decreased, with a simultaneous release essentially of glucose as the free reducing sugar. Paper partition chromatography of the incubated mixture showed (i) a diminution in the concentration of added sucrose, (ii) formation of oligosaccharides between the sucrose and the zero spots, and (iii) an increase in the concentration of glucose. These observations were clearly suggestive of a dismutation of sucrose to fructose polymers by the intermediation of an enzyme present in the agave juice.

By step-wise precipitation of the stem juice with ammonium sulphate, the enzyme was concentrated about twenty-fold, and its characteristics studied. On dialyzing the concentrate and filtering, a cell-free, clear solution was obtained undiminished in activity, showing that no dialysable cofactor formed part of the enzyme system. None of the fractions obtained by using ethanol of different strengths was active.

Polyfructosan (isolated from the Agave) by itself or with sucrose, when incubated with the enzyme, remains unchanged proving that polyfructosan is not necessary for the reaction. Thus, the enzyme from this plant source differs fundamentally from the corresponding enzyme from Jerusalem artichoke which, according to Edelman and Bacon,² transfers fructose from inulin to sucrose. Incubation of the enzyme with glucose, fructose or their mixtures or with raffinose does not result in the formation of oligosaccharides. In this manner, this plant enzyme resembles the mould enzymes described by Bealing and Bacon.³

The optimum pH for the enzyme action is 5.6-5.8. The enzyme has maximum activity at 37° C. and gets inactivated at 55° C.

Four oligosaccharides are formed. Analysis of the spot immediately below sucrose has been completed and shows it to be made up of two units of fructose and one unit of glucose (cf. Dedonder,⁴ Edelman and Bacon,² Pazur⁵). Quantitative analyses of the carbohydrate spots separated on the chromatogram confirm the stoichiometric relationships between sucrose and formed sugars as given by Dedonder⁴ and Pazur.⁵

The authors wish to record their thanks to Dr. V. Subrahmanyan for his interest in the work.

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ACIDS AND SUGARS IN THE 'KAMRAKH' FRUIT, *AVERRHOA* *CARAMBOLA*, LINN.

WINTON,¹ while quoting analytical data from previous reports^{2,3} on *A. carambola*, doubts if oxalic acid is the free acid present in the fruit. Kalyankar and co-workers⁴ found only malic acid by chromatographic analysis of the fruit extract. The tree belongs to the family Oxalidaceae and the cells of the pericarp tissue of the fruit have within them small oxalate crystals.¹ It is definite that the fruit contains some amount of oxalic acid, free or combined, since the clear juice, on neutralisation and addition of calcium chloride solution, gives a white precipitate insoluble in acetic acid and capable of reducing acidified permanganate after dissolution in dilute sulfuric acid.

Extensive chromatographic studies with the sour and sweet varieties of the fruit collected from different sources, using the techniques of Giri and co-workers,⁵ and Kalyankar and co-workers,⁴ show that the sweet variety contains both oxalic and malic acids, while the sour variety contains only oxalic acid. Accordingly, quantitative determinations for malic acid and oxalic acid were done by the polarimetric uranyl acetate method and calcium oxalate method⁶ respectively, using clear extracts from known weights of the fruits. Simultaneous determinations of moisture and reducing sugars⁷ were also carried out (Table I).

Chromatographic analysis of the juice of both varieties of fruits for sugars, using the ascending

technique with butanol acetic acid water (4:1:5) as solvent mixture and benzidine trichloroacetic acid as developer showed the presence of traces of sucrose, moderate quantities of fructose and large proportions of glucose.

TABLE I

Variety of fruit	Moisture %	Reducing sugar %	Titration acidity ml. of 0.1 N NaOH = 100 g. fruit	Oxalic acid %	Malic acid %
Sweet	91.7	3.83	41	0.16	0.06
Sour	89.9	4.60	98	0.61	..

Most of the free acidity is due to oxalic acid as could be seen from the titration acidity figures. A small percentage of the oxalic acid is perhaps present as sodium or potassium salts, the presence of any significant quantities of calcium oxalate being ruled out since the fruit has very low calcium content.⁸

The figures given above are for ripe fruits. The oxalic acid content of some unripe sour fruits runs as high as 1 per cent. It is relieving to note that only the sweet ripe fruits of low acid content are generally eaten as such, the sour variety being used for pickles and preserves.

The authors thank Dr. V. Subrahmanyam for his keen interest in the work.

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THE RELATIONSHIP BETWEEN FOLIC ACID AND BIOTIN

In the course of our investigation on the biochemical functions of biotin, a member of the vitamin B complex, we found that it was able to overcome the growth inhibitory effects of the insecticide, γ -hexachlorocyclohexane, in the Ascomycete fungus, *Neurospora crassa*.¹ In order to understand more about the detailed mechanism of action of the insecticide, experiments were conducted to see whether other

aspects of inositol metabolism were affected under the influence of γ -hexachlorocyclohexane. Although nothing definite is known as to the metabolic functions of inositol, the amount of the vitamin occurring in pancreatic amylase, as determined by Williams, Schlenk and Eppright,² is such as to suggest that it may be a component of the system. Lane and Williams³ observed that the inhibition by lindane of pancreatic α -amylase was overcome by inositol, and this strengthened the above view that inositol may function as an integral part of the enzyme system. Although Fisher and Bernfield⁴ were not able to confirm the suggestion using pure and crystalline malt and pancreatic α -amylase, Ramachandran and Sarma⁵ observed in the course of their investigation on the synthesis of α -amylase by pigeon pancreas *in vitro*, that the insecticide inhibited the synthesis of the enzyme. Further, Dulaney and Grutter⁶ indicated that inositol is the only vitamin that is able to increase riboflavin synthesis in *Eremothecium ashbyi*, and that biotin and thiamin, which this organism normally requires for its growth, do not increase the riboflavin level over that obtained by inositol alone in the culture.

We have found in the present investigation using *Aspergillus oryzae* as the test organism, that the two actions of inositol in the cell, production of amylase and riboflavin, are inhibited by γ -hexachlorocyclohexane, and that biotin is able to overcome the inhibitory effects to an appreciable extent, in conformity with our earlier observation.¹

The organism was cultured on a modified Czapek-Dox medium and amylase and riboflavin were determined after ten days growth, amylase by the method of Somogyi⁷ and riboflavin by the standard fluorimetric procedure as outlined by Scott, Hill, Norris and Heuser.⁸ The organism was cultured in 250 ml. Erlenmeyer flasks containing 25 ml. of the basal medium and the inhibitor was made up in ethanol and added before sterilisation.

Studying the influence of the individual members of the B group of vitamins, it was observed that folic acid exerted an antagonistic effect with respect to biotin. In the presence of folic acid, it was found that γ -hexachlorocyclohexane inhibits the production of amylase and riboflavin by *Aspergillus oryzae* to a far greater extent than in its absence, although folic acid by itself does not have any effect in the absence of the insecticide. The results, presented in Table I, indicate that while biotin is able to overcome the inhibitory effects of the insecticide

to an appreciable extent, folic acid augments the inhibitory action, and that, in the presence of folic acid, biotin in the concentration employed is not able to overcome the inhibition. A similar instance of antagonism between folic acid and biotin has been reported by Sreenivasan⁹ relating to nucleic acid synthesis by *Lactobacilli*. Full details of this investigation will be published elsewhere.

TABLE I

Relation of folic acid and biotin to γ -hexachlorocyclohexane inhibition in *Aspergillus oryzae*

supplement/25 ml.	amylase units*	riboflavin γ /g.
Basal Medium (BM)—control	2250	24.6
BM + folic acid (5 γ)	2238	24.5
BM + γ -hexachlorocyclohexane (1 mg.)	1720	18.2
BM + γ -hexachlorocyclohexane (1 mg.) + biotin (1 γ)	2060	21.8
BM + γ -hexachlorocyclohexane (1 mg.) + folic acid (5 γ)	1410	16.5
BM + γ -hexachlorocyclohexane (1 mg.) + folic acid (5 γ) + biotin (1 γ)	1450	16.3

* mg. reducing sugar (glucose equivalent) formed by 1 g. mycelium in one hour at 37° C. at pH 5.6.

The authors wish to express their grateful thanks to Dr. W. H. Tisdale, and Messrs. Hooker Electrochemical Co., New York, for the gift of a 99 per cent. pure γ -hexachlorocyclohexane sample, and to Messrs. Hoffman La-Roche & Co., Inc., for synthetic d (+) biotin used in this investigation.

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PHYTOTOXICITY IN COTTON PLANTS DUE TO DDT SPRAYING

THERE is not much evidence of any phytotoxicity in cotton plants due to DDT spraying though some account of the same due to BHC is given by McKinlay.¹ Field experiments were conducted in the I.A.R.I. Farm during 1952-54 for the control of bollworms of cotton using 0.25 per cent. DDT and 0.0325 per cent. γ -BHC water suspensions at the rate of about 50 gallons per acre in fortnightly and monthly intervals. Spraying was started on 28-7-1952 and 18-8-1953 and continued till about the end of October during the two years respectively. In both the years in plots sprayed with DDT in fortnightly intervals the growth of the new leaves in many plants was checked and many leaves had assumed linear shape. The new flowers and bolls were also very much reduced in size. In addition, a good many buds and flowers were seen withering with a consequent lowering in the number of bolls set during the first year, such withering during the second year, however, being less marked. These abnormalities observed from about the middle of September were distinctly present in all the plots where DDT was sprayed in fortnightly intervals, the plots receiving DDT spray in monthly intervals or those receiving BHC in fortnightly or monthly intervals apparently not showing such abnormalities. These observations stress the need for caution in the use of DDT or BHC for the control of pests of cotton.

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PARTHENOGENESIS AND ALLOPOLY- PLOIDY IN THE MELANIID SNAILS (GASTROPODA-PROSOBRANCHIA)

COMPREHENSIVE accounts of parthenogenesis among animals have been given recently by Suomalainen¹ and Peacock.² Among Molluscs only two instances of parthenogenesis, viz., *Campeloma rufum* (Mattox)³ and *Potamopyrgus jenkinsi* (Sanderson)⁴ are known. In the latter polyploidy is probably combined with parthenogenesis, the continental race being a diploid, and the British race a polyploid. Polyploidy is not infrequent among parthenogenetic animals but they are all instances of autopolyploids. As White⁵ has pointed out there is no

authenticated record of allopolyploidy occurring in nature in animals.

I have been studying the cytology of some of the Melaniidae, a family of freshwater prosobranch gastropods. *Melania crenulata*, *Paludomus tanschaurica* and a few species of the *Melanoides* have been investigated. The latter prove to be of considerable interest, as they show parthenogenesis and evidences of allopolyploidy. A cytological study of *Melanoides tuberculatus* shows that the species is composed of two distinct races, a diploid one with $2n = 32$ chromosomes and a second race with 90-94 chromosomes, evidently at the hexaploid level. The phenotypic differences between these two races are slight, the diploid race having a slightly ridged shell and the polyploid a relatively smooth shell. These differences are not of sufficient importance taxonomically for regarding the two races as distinct species. Both the races are parthenogenetic. Over 10,000 specimens of the typical or diploid race have been examined without coming across a single male. In the polyploid race, however, exceptional males are met with occasionally, i.e., about 3 per cent. of the population. The spermatogenesis of these exceptional males shows that they are all sterile as the spermatids undergo degeneration. Further interest is found in the abnormal meiotic phenomena of these males. In the first metaphase, a varying number of univalents, bivalents and some multivalents are present. The irregular distribution of the univalents is very characteristic at this stage (Figs. 1 and 2). The meta-

phase plates are strikingly similar to those observed in several plant hybrids. The heterozygosity of the race is further suggested by the presence of bridge and fragment mostly at the second division, indicating relatively inverted segments in homologous chromosomes. The race is therefore an authentic instance of allopolyploidy occurring in nature combining both structural and numerical hybridity. At diakinesis the multivalents show a ring-like arrangement (Fig. 3).



FIG. 3. Ring formation at diakinesis ($\times 4,000$).
(Acetocarmine preparation)

The other two species of *Melanoides* investigated, *Melanoides lineatus* and *Melanoides scabra*, are also parthenogenetic. Exceptional males are also met with in *Melanoides lineatus*, but they are much rarer, being about 0.01 per cent. of the population. These also show hybrid structure and are allopolyploids. *Melanoides lineatus* has 71-73 chromosomes and *Melanoides scabra* 76-78 chromosomes.

The occurrence of parthenogenesis in the species of *Melanoides* studied has been inferred, not only from the absence of males and absence of sperms in the oviduct and broodpouch, but also confirmed by the cytological investigation of the maturation divisions of the ovum and the early cleavage stages in development. The chromosome numbers before and after each of the two maturation divisions and at the first cleavage division have been checked with those in the polar body. The parthenogenesis is apomictic with two equational maturation divisions as in *Pycnoscelus surinamensis* investigated by Matthey,⁶ but there is no pairing of chromosomes, and in the early prophase the leptotene chromosomes show a longitudinal split. Detailed observations on the mechanism

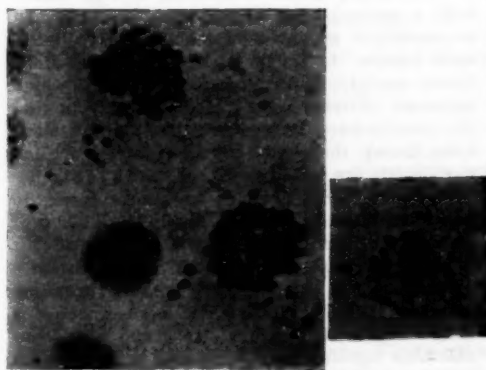


FIG. 1. Two metaphase-I plates Polar view ($\times 1,100$).
Univalents are lying scattered
(Acetocarmine preparation)

FIG. 2. Metaphase-I Equatorial view ($\times 1,100$).
Univalents near the poles (A Feulgen squash).

of parthenogenesis are in progress and will be reported shortly.

The habits of the two races of *Melanoides tuberculatus* are worth mentioning in the context of their chromosomal differences. The typical or diploid race occurs in very restricted localities, but the polyploid race has been collected from several localities in the Madras and the Andhra States, and from different habitats including wells with brackish water having a salinity of 24 ‰. No appreciable difference in cell-size could be detected between the diploid and the polyploid races. Further work including controlled breeding experiments is in progress.

My thanks are due to Prof. J. B. S. Haldane and Dr. H. G. Callan for suggestions, to Dr. H. S. Rao for verification of the species and to Prof. R. V. Seshaiya for guidance.

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SEX CHANGES IN THE WOOD-BORING PELECYPOD, *TEREDO NAVALIS* LINN.

THE phenomenon of sex reversal is of wide occurrence among pelecypoda. Calman¹ and others have stated in their account of *Teredinidae* that while some species of *Teredo* are hermaphroditic, in others the sexes are separate. Protandry in *Teredo* has been indicated, although not recognised as such, since the work of Quatrefages nearly a century ago, who reported a proportion of only 5 or 6 males in each 100 individuals of *Teredo norvegica*. Nelson² later suggested an even greater disparity of the sexes, with as many as 500 females to 1 male among large individuals. Yonge,³ on the other hand, found definite evidence of protandry in two specimens of *T. norvegica*. Coe^{5,10} worked in detail on the sex problem in *Teredo* and came to the conclusion that protandry does exist in this form and 90 per cent. of the adult population are females. Grave^{6,9} while agreeing with Coe in the occurrence of sex inversion in *T. navalis*, maintains that the gonads of the young are not exclusively male as

required by the conception of the sexual cycle as protandric. The sex, according to this author, is not rigidly fixed and there may be inversion of the sexes from male to female or from female to male at any time during the breeding season. In view of his findings Grave concluded that *T. navalis* is not essentially or principally protandric. Kofoid and Miller¹¹ observed that males of *T. navalis* in San Francisco Bay are commonly smaller than females, but found no evidence that actual change of sexual phase might occur.

From the above account, it is evident that all the workers are agreed that a change of sex in *Teredo* occurs but the whole controversy lies in the fact as to whether this change indicates protandry. For ascertaining this, we examined the gonads of 129 specimens of *Teredo navalis* of different size groups. The length of the animal after its removal from the burrow was measured and the condition of gonad ascertained. Some of the gonads of different size groups were fixed in Bouin's fluid and later sectioned and stained for detailed histological study.

The statistical data are given below:—

Length of the animal	True males	Ambisexual males	Herma- phrodites	Females	Total
1-20 mm.	17	33	2	1	53
20-30 mm.	6	2	..	30	39
30-50 mm.	5	..	1	23	21
50 mm. and above	1	8	9

The primary gonad is bisexual as Coe⁴ stated with a cortical layer of potential ovogonia and a medullary group of spermatogenic cells in each follicle. In the first size group, out of 53 forms examined there were 17 forms which represent extreme aspect of masculinity in that the gonads have only a very few minute oocytes along the walls of the follicles. Such individuals are called as "True males" (Fig. 1). The 33 ambisexual males are those forms in which the gonads reveal a highly variable proportion of spermatogenic and ovogenic cells (Fig. 2). There are only two hermaphrodites in the first size group which contains functional gametes of both types. The occurrence of a single female in the first size group is of considerable significance. According to Coe^{7,8} such females make their appearance by omission of the initial male phase as it is known to be in some other species of normally protandric molluscs.

In the next size group there are 30 females out of 38 specimens observed (Fig. 3). Evi-



FIG. 1



FIG. 2

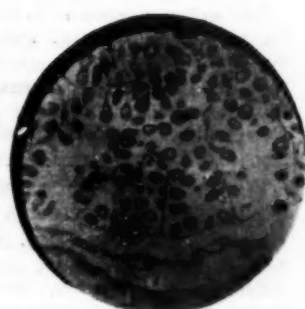


FIG. 3

FIG. 1. *T. navalis*, T.S. gonad showing spermatogenic follicles.

FIG. 2. *T. navalis*, T.S. through hermaphrodite gonad showing cortical layer of large ovocytes with relatively small number of spermatocytes in centre.

FIG. 3. *T. navalis*, T.S. gonad of female showing ova in the follicles.

dently these are the few forms which have changed their sex from the initial male phase.

In the last two size groups the true males continued to be present, and these are supposed to remain as males for the rest of their life. The last size group includes the adult *Teredo*. According to our observations the females are more numerous than males in this size group. Further observations are being made.

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ON A NEW RECORD OF A BETHYLID PARASITE ON RHIZOPERTHA DOMINICA, FABR.

THE author came across a few Hymenopterons (Bethyridæ) in wheat infested by *Rhizopertha dominica*, Fabr. As far as the writer is aware, there is no published record of any Bethyrid parasite on *R. dominica*. The adult female (Fig. 1) is black in colour and is very agile. It measures about 3.0 mm. \times 0.5 mm. The female is slightly bigger with a larger abdo-

men. Under laboratory conditions a female which has copulated lives upto 8 days without any food, while the male lives upto 5 days without food, at an average maximum temperature of 93° F. and a minimum temperature of

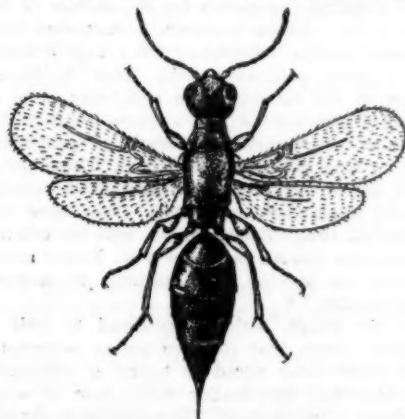


FIG. 1. Bethyrid parasite on *Rhizopertha dominica*, \times 18.

80° F., and a mean relative humidity of 75 per cent, whereas the uninated male and a virgin female lived for 4 days and 7 days respectively under the above conditions. Preliminary studies on the effect of different sugars, viz., glucose, fructose, raisin pulp and sucrose solution on the longevity of the adult parasite indicated that glucose served as the best food (survival value: 17 days). The mating takes place within a day after emergence and lasts from half-a-minute to about one minute. The females were found predominating in the cultures. The first adult of the succeeding generation was observed after 13 days. Further studies are being continued.

The writer is indebted to Dr. E. S. Narayanan for kind encouragement and facilities for the above studies.

Div. of Entomology, SNEHAMOY CHATTERJI.
Indian Agric. Res. Inst.,
New Delhi, December 9, 1953.

INTER-GENERIC HYBRIDIZATION BETWEEN *BRASSICA* AND *RAPHANUS*

In the course of *Raphano-Brassica* hybridisation during the last two years, attempted in different seasons when the plants were in flower, special efforts were made to cross *Brassica oleracea* (Cauli-flower), ($2n=18$) as female and *Raphanus sativus* (Radish), ($2n=18$) as male, as it had been reported by workers^{1,4} that the cross did not succeed with *Brassica oleracea* as female. During the course of the present investigation it was observed that *Raphanus* female and *Brassica* male crosses were fairly successful, whereas the reciprocal cross did not succeed at all.

To examine the causes for the failure of the cross in the reverse direction, emasculated buds of each species (*Raphanus* BR.1 and *Brassica* BR.1) were pollinated with fresh functional pollen of the other species and were fixed in formol-acetic alcohol and carnoys solution for 24 hours, after varying intervals of pollination ranging from 6 hours to 96 hours. These pistils were dehydrated and infiltrated in a *n*-butyl alcohol series⁵ and embedded. They were sectioned at 10μ . Sectioned as well as crushed pistils were stained in cotton blue. Pollen grains of both the species were cultured on sucrose-agar medium.^{1,3}

It was found, both in sectioned as well as crushed pistils, that *Brassica* pollen germinated very freely after about 18 hours of pollination and also that fertilisation took place in about 36 hours of pollination. Germination of *Raphanus* pollen on *Brassica* stigma was very poor, and was calculated to be about 4 per cent., irrespective of the time-interval of pollination. These pollen grains, which had grown pollen tubes, were found to be on the stigmatic surface without any penetration into the *Brassica* styles. Scraping the stigmatic surface before pollinating the *Brassica* stigmas did not result either in any increase in the germinability of *Raphanus* pollen, or in the few pollen tubes growing down the *Brassica* stylar tissue. Pollen tube growth rate in separately cultured grains was almost similar in both the cases.

It may also be mentioned that the style measurements of the two species in question are the same. The style lengths of *Brassica* and

Raphanus are 9.6-9.7 mm. and 9.5-9.8 mm. respectively. Thus, the failure of the cross in the reciprocal direction may be interpreted as due to the presence of some inhibiting factor or factors, the nature of which has to be determined and which act as a barrier to pollen tube growth in *Brassica* styles and its penetration into them—a phenomenon characteristic of speciation.

The above investigation was carried out on the material supplied by Dr. R. H. Richharia, to whom I am deeply indebted for guidance and encouragement.

Agri. Res. Inst., K. N. SUBRAMANYAM.
Sabour (Bhagalpur),
October 12, 1953.

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BREEDING HABITS OF THE INDIAN SHEATH TAILED BAT *TAPHOZOUS* *LONGIMANUS* (HARDWICKE)

The reproductive patterns of bats so far studied can be classified into the following categories:

(i) Copulation occurs in autumn and the spermatozoa hibernate inside the genital tract of the female throughout winter and fertilise the ova in the next spring as in *Vespertilio murinus*, *Rhinolophus ferrum equinum*,⁹⁻¹¹ the British horse-shoe bats⁶ and *Myotis lucifugus lucifugus*.¹² (ii) Copulation normally occurs in autumn and the sperms are stored inside the genital tract of the female; but there may also occur copulation in winter and spring as in *Myotis lucifugus lucifugus*.⁴ (iii) Copulation and fertilisation occur in autumn as in *Lyroderna lyra lyra*.³ (iv) Copulation as a rule occurs in spring and is immediately followed by fertilisation and pregnancy as in *Nyctinomus cynocephala*,⁵ *Miniopterus australis*¹ and *Scotophilus wroughtoni*.² In all the cases mentioned above, pregnancy occurs only once a year whatever the period of copulation be. Occurrence of more than one pregnancy in a year was recorded by Matthews^{7,8} in *Nycteris luteola*, which becomes pregnant during lactation period. (v) There is no restricted breeding season but breeding occurs all the year round, and pregnancy occurs in the lactation period as in *Desmodus rotundus*.¹³

Collections of specimens of *Taphozous longimanus* were started in October 1947 and are still being continued. Specimens were collected round about Nagpur and Amaravati (India),

and collections were made practically in all the months of the year. The following table is included to give the data of collections so far made with details of information necessary for the present study:

TABLE I

Month	Females				Males		Total
	Pregnant	Lactating	Non-Pregnant	Immature	Adults	Immature	
January	.. 3	2	1	1	3	..	10
February	.. 4	1	2	2	5	..	14
March	.. 8	3	1	1	3	1	17
April	..		No Collections				
May	..		No Collections				
June	.. 3	3	1	2	1	1	11
July	.. 1	1	3	1	2	..	8
August	.. 15	3	..	2	2	1	23
September	.. 11	8	1	5	12	2	39
October	.. 12	8	3	2	4	2	31
November	.. 4	4	4	2	3	2	19
December	.. 2	4	..	1	5	1	13
Total	.. 62	38	16	19	40	10	185

Note.—The word 'immature' has been used in the above table to denote young specimens that were found attached to the nipples of the mothers when the mothers were shot.

On the basis of the study of the collected material the following observations have been made: (1) pregnant females were collected in all the months of the year; (2) in any one collection there were females carrying foetuses at different stages of development and also females at different stages of sexual activity as revealed by the microscopic examination of the sections of the ovaries; (3) lactating females were collected in all the months of the year; (4) 16 lactating females each carrying a young at the breast and collected during different months of the year showed, on dissection and sectioning, that pregnancy had again started in one of the horns of the uterus. In 8 of these specimens the ovary on the non-pregnant side showed a distinct scar indicative of the corpus luteum of the previous pregnancy; (5) males in full spermatogenic activity were collected in all the months of the year.

Taphozous longimanus thus resembles *Desmodus rotundus*¹³ in its breeding behaviour. There is no restricted breeding season, but breeding occurs throughout the year. Further, these bats experience pregnancies in quick succession as pregnancy starts even before the lactation period is over, and in such cases,

pregnancies alternate between the two horns of the uterus.

Two interesting facts may, however, be mentioned—that *Lyroderma lyra lyra*,³ which is also found in the same locality, has a sharply restricted breeding season; and secondly, that from the point of view of climatic conditions, Nagpur experiences sharply defined seasons, winter being fairly cold and summer being very hot and the rainy season being restricted to June, July, August and September. These points are mentioned here because two species of bats inhabiting the same locality have very different sexual rhythms.

Full details of sex-cycle in *Taphozous longimanus* are being worked out and will be reported soon.

Dept. of Zoology,
College of Science,
Nagpur, November 7, 1953.

A. GOPALAKRISHNA.

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A REINVESTIGATION OF THE EMBRYOGENY OF *ISOMERIS ARBOREA* NUTT

In a paper entitled "Some New Features in the Reproductive Cytology of Angiosperms, illustrated by *Isomeris arborea*" Billings¹ reported many interesting features in this plant: (1) the megaspore mother cell directly gives rise to the embryo-sac; (2) the mature embryo-sac is 3-nucleate; (3) fertilization is absent; (4) the endosperm shows peculiar multinucleate nodules; and (5) the embryo arises from one of the endosperm nodules.

In a reinvestigation Maheshwari and Khan² have shown that the megaspore mother cell undergoes the usual reduction divisions and the mature embryo-sac is monosporic and 8-nucleate. They confirm the occurrence of endosperm nodules but leave the origin of the embryo as an open question to be decided by further study.

Recently we obtained some critical stages refuting Billings' theory of the endospermic origin of the embryo. In all early stages the embryo is seen in the normal zygotic position and a comparison of the stages shown in Figs. 1-7 leaves no doubt that the embryo arises from the egg. Billings' statement that "no true egg is formed" is contradicted by our Fig. 1.

the embryo-sac. He adds, however, that "this activity seems to serve no important useful purpose". Here again our finding is that the synergids are ephemeral and inactive (Fig. 1) and the cell row is a product of divisions of the egg.

The most important point which Billings tried to make out is that the embryo arises from an

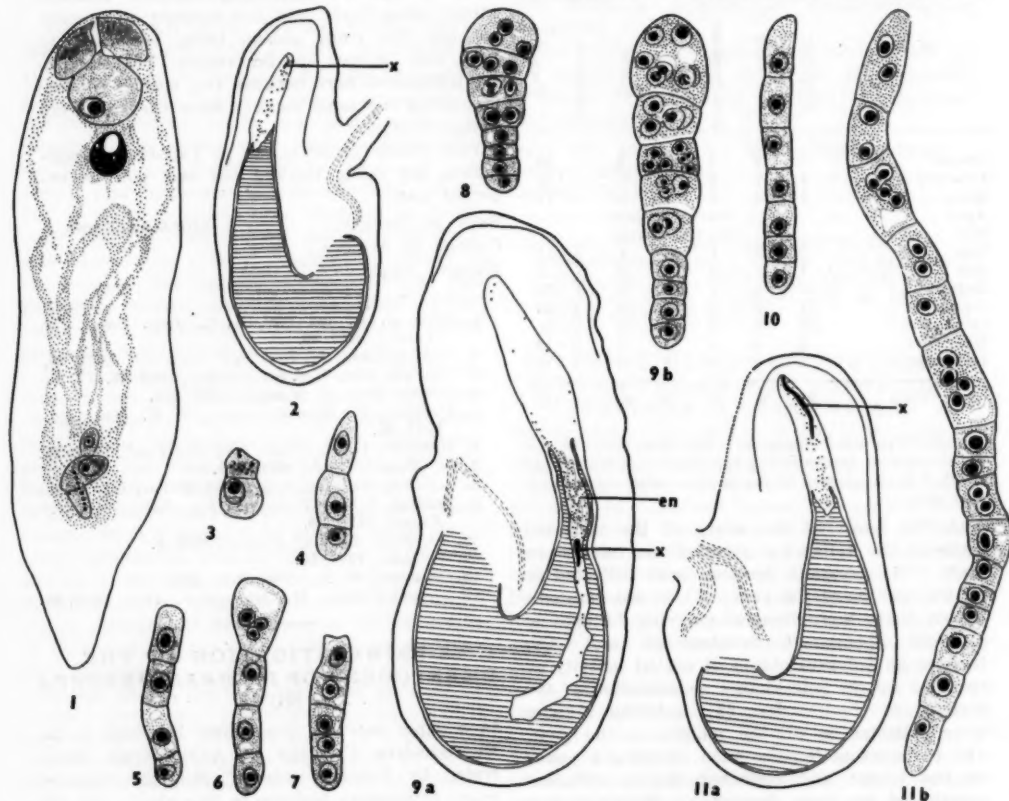


FIG. 1. Mature embryo-sac, $\times 383$.

FIG. 2. L.s. ovule showing position of proembryo (marked x) during early stages. The dots in the embryo-sac represent endosperm nuclei, while the nucellar tissue is indicated by horizontal lines, $\times 37$.

FIGS. 3-7. Proembryos at different stages of development; all have arisen in the position marked x in Fig. 2, $\times 383$.

FIG. 8. Proembryo with multinucleate suspensor cells. This was found considerably below the micropylar end, $\times 383$.

FIG. 9a. L.s. ovule showing endosperm nodules (en) in the middle part of the embryo-sac; the proembryo is marked x, $\times 37$.

FIG. 9b. More highly magnified view of proembryo of Fig. 9a, $\times 383$.

FIG. 11a. L.s. ovule showing long filamentous proembryo at x, $\times 37$.

FIG. 11b. More highly magnified view of proembryo marked x in Fig. 11a; most of the basal cells of the proembryo are multinucleate, $\times 383$.

Billings states that occasionally a synergid becomes richly protoplasmic and forms a cell row extending down from the micropylar end of

endosperm nodule. He writes: "A search for young embryos in ovules with only a moderate amount of endosperm has always yielded

negative results. Only after the ovule has reached a comparatively large size, and nodule formation has about reached completion has the presence of an embryo been noted." Since there is no established case of a similar nature known in any angiosperm, we paid special attention to this point and can state definitely that while older embryos are found considerably below the micropylar end of the embryo-sac, this is certainly not the case in early stages. Proembryos of the type shown in Figs. 3-7 and 10 arise in the position marked x in Fig. 2 long before there is any trace of endosperm nodules. They originate mostly by transverse divisions and often form a long uniseriate row of cells of which a few lying towards the micropylar end become multinucleate (Figs. 11a, 11b). The different position of other proembryos is a derived state caused at least partly by the extension of the micropylar end of the embryo-sac which continues to grow leaving the embryo behind (Fig. 9).

If the embryo were really to arise from an endosperm nodule, polyembryony should have been a common occurrence in *Isomeris*, for all the nodules are more or less alike and should have a similar potentiality. Since Billings never found more than one proembryo in an ovule (we are able to confirm this), it is surprising why he did not consider this point as a possible objection to his interpretation.

It is concluded that there are no exceptional features in the embryology of *Isomeris* excepting a somewhat abnormal position of the embryo and the presence of endosperm nodules which are quite prominent as well as numerous and are seen to differentiate soon after the initial wave of free nuclear divisions is over. Endosperm nodules, however, occur in a few other plants also, viz., *Musa errans*,³ *Impatiens roylei*,⁴ *Stackhousia linariaefolia*,⁵ *Capsella bursa pastoris*,⁶ *Oldenlandia corymbosa*,⁷ and it is possible that they will be discovered in many other angiosperms.

Grateful thanks are due to Dr. Elizabeth McClintock (San Francisco), Dr. M. A. Myers (San Diego State College, California), Dr. Verne Grant (Claremont, California) and Dr. E. Y. Dawson (Los Angeles, California) who very kindly provided the material on which this study is based and to the Indian Council of Agricultural Research for a research grant in connection with a scheme on "Chemical Stimulation of the Ovule". The work on *Isomeris* was undertaken in the hope that if the embryo does arise from an endosperm nodule it should

be possible, by suitable chemical treatment, to stimulate several nodules to develop into embryos. This hope was based on the findings of Billings which have now been shown to be incorrect.

Dept. of Botany, P. MAHESHWARI.
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Delhi-8, January 8, 1954.

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OCCURRENCE OF THE GROUND SHARK *CARCHARHINUS GANGETICUS* (M.H.) IN THE RIVER MAHANADI

Carcharhinus gangeticus (M.H.) has not so far been caught from Orissa rivers. Day¹ makes specific mention that this shark is common in the seas of India, ascending rivers far above the tidal influence. The bulletin² 'Preliminary Guide to Indian Fish, Fisheries, Methods of Fishing and Curing' notes that the Ground Shark of the rivers is very common in the Bay of Bengal. The Fisheries Department of the Government of Orissa has been extracting shark liver oil from these unwanted variety during the last six years. The production of fish-meal from the flesh has started since three years. However, so far as we are aware, this is the first time that these sharks have been caught by fishermen at the Zobra-Barrage of the River Mahanadi. The distance of the Barrage from the mouth of the river is about 60 miles. Usually the sharks are caught from the different centres situated along the sea coasts, the Chilka Lake and the mouths of the larger rivers.

The Zobra fishermen caught these fishes from the last week of July 1953. The bait used are usually small-sized *Hilsa ilisha* (Ham.), *Wal-lago attu* (Bloch) and *Mystus aor* (Ham.) ranging from 6" to 2'. The bait is entangled to a large iron hook and attached to a long chord, commonly known as 'Suti'. This shark is known in Oriya as 'Mundah Magara' or sometimes 'Magara'.

Table I shows the dates of catch, total length, furcal length, yield of liver oil and fish-meal. It is observed that the yield of liver oil and

fishmeal do not depend on the length of the shark. It may be noted here that these fishes were caught during the new moon and full moon dates and that all the specimens were male. The flood level of the river was quite high.

TABLE I

Date of catch	Total length	Furcal length	Weight (lb.)	Liver oil (lb.)	Fishmeal (lb.)
31-7-53	7' 1/2"	6' 1"	121
3-8-53	6' 10 1/2"	5' 11"	..	3	10
29-9-53	6' 1"	5' 2"	..	8	8
30-9-53	6' 6 1/2"	5' 6 1/2"	114	4 1/2	6
1-10-53	6' 5"	5' 5 1/4"	115	3	7

* Given to the Hospital.

Besides the five specimens brought to our technological laboratory, we were not able to study three other fishes which were sold at the local market.

We are indebted to Sri. G. N. Mitra and Sri. G. B. Mohanty for their interest and suggestions.

Dept. of Fisheries,
Cuttack,
November 14, 1953.

P. MOHAPATRA.
A. B. ROY.
B. NAYAK.

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CHROMOSOME NUMBERS OF SOME INDIAN ECONOMIC PLANTS

THREE lists of chromosome numbers of plants native to and introduced into India and now forming part of the Flora of India were published.¹⁻⁴ A further list is now given below. In the case of *Monstera deliciosa*, Janaki Ammal⁵ has recorded a number $2n=24$. A sample of sorghum received in 1937 by the Millets Specialist, Coimbatore, from R. E. Karper, Vice-Director, Texas Agricultural Experiment Station, Texas, U.S.A., labelled as Tunis grass with multiflorous spikelets has been found to have intermediate characters between *S. halepense* and *S. sudanense*. Tunis grass is *S. virgatum*.⁶ The characteristics of this sample is unlike *S. virgatum*. *Pennisetum subangustum* was received from the West African Inter-Territorial Secretariat, Accra, Gold Coast.

Species	Chromosome numbers		Remarks
	n	2n	
GUTTIFERÆ			
<i>Garcenia tinctoria</i> Dunn.	c.80		Fruit Research Station, Kallar, Nilgiris
<i>Garcenia Cambogia</i> , Desr.	c.58		do. do.
AMPELLIDACEÆ			
<i>Vitis vinifera</i> , L. Green grape (Krishnagiri type)	38		Local garden, Coimbatore
<i>Vitis vinifera</i> , L. Blue grapes	38		do. do.
<i>Vitis vinifera</i> Kishmish (seedless)	38		do. do.
<i>Tetragium sulcatum</i> Gamble.	22		Top-slip Anamalais, 2,400 ft.
<i>T. lanceolarium</i> Planch.	44		do. & Rangaswami Hills
<i>Cissus pallida</i> Planch.	26		Anamalais, 2,500 ft.
<i>C. Heyneana</i> Planch.	28		do. do.
<i>C. glauca</i> Roxb.	24		do. & Marudamalai, 3,000 ft.
<i>C. discolor</i> Blume.	24		do. do.
SOLANACEÆ			
<i>Solanum pubescens</i> , Willd.	24		Bhavanisagar, Coimbatore
ARACEÆ			
<i>Monstera deliciosa</i> , Liemb.	48		F. R. S. Kallar, Nilgiris
GRAMINEÆ			
<i>Sorghum virgatum</i> ?	10	20	U. S. A. Texas Exp. Stn.
<i>Rottboellia exaltata</i> , Linn.	18		Weed, Coimbatore
<i>Setaria palustris</i> , Stapf.	27	54	Rain forests and Hills, 3,000 & above
<i>Pennisetum subangustum</i> , S. & H.	18		Gambia, West Africa
<i>Oryza granulata</i> , Nees & Arn.	12	24	Anamalai Hills, 2,500 ft.
<i>O. breviligulata</i> , A. Chevalier & Roehrich	24		French Sudan, Africa
<i>O. brachyantha</i> , A. Chevalier & Roehrich	24		do. do.

The numbers in *Vitis vinifera* conform to those already recorded for other cultivated varieties of grapes.⁵ In the genus *Cissus* apart from the aneuploid series certain peculiarities are also noted in the chromosomes. The genus *Garcenia* presents high numbers with small chromosomes. *G. tinctoria* probably has numbers nearer to *G. mangostana* while *G. cambogia* is closer to *G. indica* or *G. speciosa*.² *Pennisetum subangustum* is a tetraploid species of the section *Eu-pennisetum*. More detailed

work is being done on these species and the results will be published elsewhere.

Cytogenetic Laboratory, N. KRISHNASWAMY.
Agric. Res. Inst., V. S. RAMAN.
Coimbatore, B. V. SHETTY.
October 31, 1953. P. CHANDRASEKHARAN.

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NUCLEATED VESSEL ELEMENTS IN TENDRILS OF *VITIS REPENS*, W. & A.

It is usually stated that vessel elements or members are non-living cells. Esau¹ says: "In the mature state, tracheids and vessel members are more or less elongated cells with lignified secondary walls and devoid of protoplast". Later, she writes (p. 225) that after the formation and lignification of the secondary walls, "the swollen parts of the primary wall break down, and finally the protoplasts die and disappear". In other words, the disappearance and loss of the protoplast usually synchronizes with the formation of perforation plates (Eames and MacDaniels,² Fig. 49; Esau,¹ Figs. 11-13).

While examining macerations of the tendrils of *Vitis repens* growing at Surat, some mature vessel elements of secondary xylem were found to contain a nucleus and cytoplasm (Figs. 1, 2a and 2b). The vessel elements are fairly elongated cells with lignified cell-walls, scalariform perforations and simple pits on the lateral walls. Among the nucleated vessel elements, some showed a small amount of weakly staining cytoplasm and nucleus (Fig. 1), while others showed more prominent cytoplasm extending about half the length of the vessel element (Figs. 2a and 2b). The cytoplasm appeared vacuolated and granular, and the nucleus, which is more or less rounded with a single nucleolus, was embedded in the cytoplasm.

The presence of a nucleus and cytoplasm in mature vessel elements is rather remarkable. The number of vessels in a tendril is very small as the secondary xylem consists mostly of fiber-tracheids, both septate and non-septate. Some of these too showed the presence of protoplasts (Figs. 3, 4 and 5).

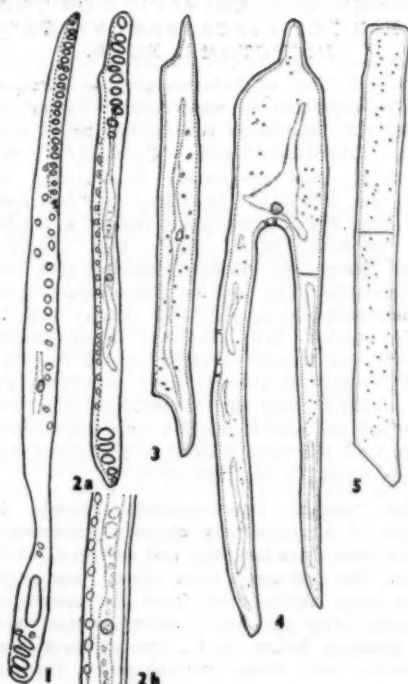


FIG. 1. A vessel element with scalariform perforation showing scanty cytoplasm and nucleus, $\times 220$.

FIG. 2a. A vessel element showing vacuolated cytoplasm and nucleus $\times 300$.

A. Part of the Fig. 2A showing the nucleus and cytoplasm, $\times 500$.

FIG. 3. Fiber tracheid with nucleus and protoplast $\times 300$.

FIG. 4. Septate fiber tracheid of peculiar shape containing cytoplasm and nucleus, $\times 220$.

FIG. 5. Septate fiber tracheid devoid of cytoplasm, $\times 220$.

Thanks are due to Prof. P. Maheshwari, who suggested to me to investigate the anatomy of tendrils, for his help and interest in the work. I also thank Shri I. N. Solanky for his helpful interest.

Biology Dept., J. J. SHAH.
M. T. B. College, Surat,
November 16, 1953.

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CHEMICAL EXAMINATION OF THE
BARK OF *TABERNAEMONTANA*
DICHOTOMA, ROXB.

FROM the bark of *Tabernaemontana coronaria* Br., Ratnagiriswaran and Venkatachalam¹ reported the isolation of two cardiac active alkaloids, tabernaemontanine, $C_{20}H_{26}O_3N_2$, m.p. 208-10° C., and coronarine $C_{44}H_{56}O_6N_4$, 2.5 H_2O , m.p. 196-98° C. (dec.) in a very low yield, and from the unsaponifiable matter a crystalline 'resin-alcohol', $C_{17}H_{32}O_4$, m.p. 180-81° C. Later, Warsi and Ahmed² reported that from *T. coronaria*, they isolated the alkaloid tabernaemontanine, m.p. 217-18° C. (dec.) and the 'resin alcohol', m.p. 185-87° C. More recently Kartha and Menon³ working on the root bark of *T. crispa* (dichotoma) have mentioned that the alkaloid could not be obtained in a pure state but the neutral fraction from the alcoholic extract of the bark yielded a crystalline substance, $C_{12}H_{20}O$, m.p. 192-94° C.

The present communication records the results of a preliminary chemical examination of the bark from the stem and root of *T. dichotoma*. The powdered bark (2 kg.) was percolated with alcohol and from the concentrate obtained after removal of solvent under reduced pressure below 50° C., the alkaloids were extracted with dilute mineral acid. The non-basic residue was freed of fatty matter by refluxing with alcoholic potassium hydroxide and the unsaponifiable fraction separated by usual methods yielded after repeated crystallisation from alcohol, a crystalline substance (3 g.), m.p. 149-52° C. After chromatographic purification on a column of neutral alumina, the material was recrystallised from alcohol and fine clusters of colourless needles (2.5 g.; m.p. 154-56° C.) were obtained. A small quantity (0.05 g.) of another colourless crystalline substance, m.p. 163-64° C., was also obtained from the alcoholic solution.

With acetic anhydride and concentrated sulphuric acid and also in the Liebermann-Burchard reaction, the crystalline compound, m.p. 154-56° C., gave a pink colour. In the Salkowski reaction the chloroform layer had a greenish tinge and the sulphuric acid layer

turned from faint yellowish red to orange in colour.

On the basis of analytical data the crystalline compound m.p. 154-56° C., which showed $[\alpha]_D^{25} = +65, 67.5$ (1 per cent. solution in absolute alcohol) has been assigned the provisional molecular formula $C_{28}H_{48}O$. (Found: C, 84.13; H, 11.93 per cent. and M.W. (Rast) 406.6; $C_{28}H_{48}O$ requires: C, 83.99; H, 11.99 per cent. and M.W., 400). The acetate prepared by treatment with acetic anhydride and fused sodium acetate, was obtained as colourless needles from alcohol, m.p. 164-67° C., $[\alpha]_D^{25} = +70.2$ (alcohol). (Found: C, 81.55; H, 11.88; $C_{30}H_{50}O_2$ requires: C, 81.45 and H, 11.31 per cent.). The benzoate was prepared by the action of benzoyl chloride in pyridin medium. It crystallised from ethyl acetate in colourless needles, m.p. 234-35° C. (Found: C, 83.2; H, 10.1; $C_{38}H_{52}O_2$ requires: C, 83.33 and H, 10.31 per cent.).

The alkaloidal content of the bark was too low (yield 0.01 per cent.). A colourless crystalline base, soluble in ether and non-phenolic in character, m.p. > 360° C. was obtained in traces from the total alkaloid. However, further work on the alkaloidal constituents had to be postponed for want of sufficient material. A preliminary investigation of the bark of *T. heyneana*, another closely related plant of the same genus, has also been carried out in this Laboratory and the results will be reported soon.

I wish to express my sincere thanks to Prof. R. C. Shah for his interest in the work and to Dr. P. C. Joshi for collecting and identifying the drug. The microanalyses were carried out by Dr. G. D. Shah and Mr. V. S. Pansare.

A. V. SUBBARATNAM.

National Chem. Lab. of India,
Poona-8, September 30, 1953.

1. Ratnagiriswaran and Venkatachalam, *Quart. J. Pharm. Pharmacol.*, 1939, 12, 174.
2. Warsi and Ahmed, *Pakistan J. Sci.*, 1949, 1, 128. and *C. A.*, 45, 4889^a.
3. Kartha and Menon, *Curr. Sci.*, 1952, 21, 315.

REVIEWS

Text-Book of Optics. Second Edition. By N. K. Sethi and S. B. Raizada. (Premier Publishing Co., Delhi), 1953. Pp. 436. Price Rs. 10.

Text-Book of Sound. By Singh and Prakash. (Krishna Publishing House, Kanpur), 1952. Pp. viii + 319. Price Rs. 7-8-0.

The above text-books are designed primarily to meet the needs of the student studying for the B.Sc. Pass Course in our Universities and constitute a welcome addition to those already available in the field.

The text-book on optics by Sethi and Raizada is divided into three parts. The principles of geometrical optics are dealt with in the course of 7 chapters and constitute the first part of the book. Part II is devoted to the treatment of the principles of physical optics in 10 chapters, the emphasis being laid throughout on fundamentals rather than on details. There is also a brief introduction to quantum theory of atomic spectra in the chapter concluding this part. Optical instruments and measurements take up the remaining 8 chapters of the book, designated as Part III.

The text-book on sound by Singh and Prakash follows the usual lines, although in view of the free use of the calculus and the fairly thorough treatment of the mathematical theory of sound, there is some justification for the authors' claim that the book, while fully catering to the needs of the B.Sc. Pass Course, may also serve as an introduction to those studying for the Honours Degree. The chapters on subjective effects of sound, the ear, audition, speech and musical scale, acoustics of buildings and ultrasonics certainly cover much useful ground outside the University syllabus. Questions and numerical problems form a useful appendix to each chapter.

While Indian authors are doing their best to produce text-books of quality, it is a pity that the get-up of most of these fall far short of what one has a right to expect, even under present conditions. Foreign publishers like McGraw-Hill, Academic Press, Inc., and the like, have set up a standard in the matter of the choice of the quality of paper, illustrations, typeset, index and presentation, especially of the cover and title pages, which it would be well for science publishers in India to be familiar with, if not also to emulate. It is to be hoped that this important aspect of the text-book, technical excellence in get-up and pro-

duction, will be insisted on even more by the authors themselves than by the young and the innocent public who patronise them.

The Proteins, Chemistry, Biological Activity and Methods. Edited by H. Neurath and K. Bailey (Published by Academic Press, Inc., New York), 1953. Vol. I, Part A, Pp. viii + 548; Part B, Pp. viii + 549-1,115. Price: Vol. I, \$ 12.00; Vol. II, \$ 13.00.

The object of this treatise is to present a comprehensive, integrated account of the chemical, physical and biological properties of proteins. The appearance of such a treatise is very timely, for many diverse methods have been developed in recent years for the study of the ultimate chemical structure of proteins and for the correlation of this with biological activity, and the task of keeping in touch with all these by reference to original literature is practically impossible. In this volume, the different aspects have been well covered by a collaborative effort, each topic being discussed by a specialist, particularly familiar with the techniques and results in his field.

The first three chapters are purely chemical, dealing respectively with isolation of proteins (J. F. Taylor), chemistry of amino acids and peptides (P. Desnuelle) and amino acid composition of proteins (G. R. Tristram). Next follow two chapters on physical methods for the study of their structure, namely, by means of X-ray diffraction (B. W. Low) and optical behaviour (P. Doty and E. P. Geiduschek). The last chapter of Part A is concerned with the electrochemical properties of proteins and amino acids (R. A. Alberty).

Part B also deals with diverse topics, although the bulk of it is devoted to the chemical interactions and modifications produced by external agents. Chapter VII by J. T. Edsall deals with the results obtained by various physical methods on the size, shape and hydration of protein molecules. The next chapter by I. M. Klotz is concerned with the interactions of proteins with ions and the methods available for investigating these and their significance in biology. Protein denaturation and the modifications produced in proteins by chemical treatment are discussed in two chapters by F. W. Putnam. The concluding chapter is by R. R. Porter on the relation between chemical structure and biological activity.

In spite of the heterogeneous treatment, the editors have done an excellent job in placing the various articles together and there is very little of overlap. There is no doubt that "Neurath-Bailey" will be the standard reference book on the subject for some time to come.

Standard Methods of Clinical Chemistry. Vol. I.

By the American Association of Clinical Chemists. (Editor-in-Chief: Miriam Reiner.) (Published by the Academic Press, Inc., New York, N.Y.), 1953.

The volume under review which is the first in the series is expected to serve biochemists engaged in clinical laboratories to aid physicians in clinical diagnosis. Laboratory aids to clinical diagnosis are necessarily on the increase and of these a biochemical laboratory plays an integral role. Tests carried out in such laboratories are sometimes cumbersome and time-consuming. This book aims at simplifying and standardising some of the more common tests for facilitating quick yet accurate results.

The American Association of Clinical Chemists with experience in this line have the necessary authority therefore to lay the respective tests for acceptance. Each method is said to be performed in the laboratory of the "submitter" and passed on to another named the "checker" who, after verifying, submits the report combining criticism and suggestions for further perfection.

The tests are arranged in this book (as far as we could see) in alphabetical order beginning with amylase, bilirubin, calcium and ending up with thymol turbidity, urea nitrogen and uric acid. The biochemist in performing these tests is also expected not only to report but integrate the results with clinical findings, with full knowledge of the limitations of the methods and their significance.

The book is also intended to help technicians in a biochemical laboratory as also junior medical men for collecting, preserving and submitting specimens to the laboratory. This information, to our mind is vital, as careless and mechanical collection and transference of specimens from the bedside to the laboratory has often vitiated results or embarrassed the laboratory biochemist.

We look forward to subsequent volumes in the series and fully trust that the present simplified manual will be of value to the laboratory biochemist in his great task of assisting the clinician to arrive at diagnosis.

V. ISWARIAH.

British Standard for Recommended Common Names for Pest Control Products. B.S. 1831, Part II. (Issued by British Standards Institution, Sales Branch, 2, Park Street, London, W. 1), 1953. Price 2 sh. net.

The British Standards Institution has just issued Part II of B.S. 1831 which consists of six common names for pure pest control chemicals well known in agriculture; Part I was published in 1952 and further lists will be published from time to time.

Of these six names allethrin and methoxychlor are already accepted as coined common names by the United States Interdepartmental Committee on Pest Control. In both the U.K. and the U.S.A. the names have been pre-empted as far as possible for common use, by recording them with H.M. Patent Office and the U.S. Patent Office, respectively.

The common name is assigned to the 100 per cent. pure chemical and is correlated with the chemical name and the formula. Where more than one chemical name is known for that material, the first which is given is in accordance with the principle recommended by the Chemical Society of London. The common names and chemical names are indexed for convenient reference and this index may afford guidance to those concerned with indexing and abstracting, as to the preferred alphabetical arrangement of these names. The numbering of the common names is a continuation of that adopted in Part I.

Bibliography on the Genetics of Drosophila.

Part II. By Irwin H. Herskowitz. (Bibliography No. 6 of the Commonwealth Bureau of Animal Breeding and Genetics, Edinburgh). Price 21 sh.

This bibliography lists the publications on the genetics of *Drosophila* (the guinea-pig of geneticists) from 1939 to 1950 and supplements the previous one of Prof. H. J. Muller. 2,824 publications (and not 2,841 as stated in the Introduction), are listed, authorwise. Some publications closely connected with *Drosophila* work are also listed. A useful innovation over Muller's Bibliography is the general title index and a systematic index classifying the work on 65 species of *Drosophila*.

There is no need to stress the importance of this publication for those interested in *Drosophila* genetics. It is also of value to all students of genetics, as the study of this genus of fruit flies has contributed greatly to that science. This bibliography may be considered essential to all research workers in genetics. Professor

Muller in his preface has pointed out, "The further the *Drosophila* researches have gone, the larger has been the number, and greater the importance of both the intellectual and biological tools available of pressing the investigations on this same material to even wider horizons and deeper levels." It is interesting to learn that there has been an increase in the rate of publications on *Drosophila*, in spite of war, post-war conditions, and suppression by political intervention.

B. MISRO.

Sand and Water Culture Methods Used in the Study of Plant Nutrition. By E. J. Hewitt. (Technical Communication No. 22, Commonwealth Agricultural Bureau, Farnham Royal, England), 1952. Pp. x + 241. Price 42 sh.

Plant life, unlike animal life, performs certain life functions that demand a very intimate knowledge of what forms of nutrition stimulate these constructive processes within the chlorophyll-bearing cells during photosynthesis. The discovery of the role of heavy metals or micronutrients in the physiological functions of plant cells has been one of major importance to horticulture and has not only stimulated fundamental and applied sand culture experimentation but also extended its scope of enquiry to the chlorophyll-less group, the fungi. Indeed, in recent years, great volume of work has been done on fungal physiological problems using heavy metals and bioassay methods have been developed as a consequence of these researches culminating in the use of common organisms like *Aspergillus niger*, under highly controlled conditions, to detect minute traces of molybdenum, copper, manganese, etc., in a mobile form at concentrations less than 0.25 gamma. This being so, the need for an authoritative book on the technique developed in recent years in the study of sand and water culture methods in plant nutrition has been there for some time and the book under review admirably fulfils the lacuna. In fact, the significance of micronutrients in plant growth and plant well-being is not to be, for long, the main importance as, indeed, plant pathologists are increasingly aware of the interactions of these heavy metals in many *in vivo* toxemia of plants and also in the puzzling question of virus multiplication in plant tissues.

The book is presented in two parts. The first summarises many of the minute details of the techniques used in the field of plant physiology, viz., container and their composition, rooting media, base exchange materials, quality of

water, methods of purifying nutrient reagents, osmotic pressure and salt tolerances, sources of nitrogen, pH, aeration, design of experiments, etc. The second summarises special techniques developed by the author and his collaborators for large-scale pot-sand cultures. The author has undertaken a difficult task in getting together tables and text-figures from many published and unpublished sources to make a very well integrated story and deserves all praise for it. The bibliography is exhaustive and the general get-up is good. It should be mentioned that the book is largely one on techniques and should be found most useful by all those undertaking micronutrient investigations with plants and also by general agronomists and horticulturists who are unaware of the great strides made in making the subject precise and scientific. These workers should, in the fitness of things, keep abreast with all the latest developments in a branch of plant physiology which has come to be regarded as a vital key to a greater understanding of plant behaviour in their soil environment, be it vegetable, fruit, cereal or micro-organism culture.

T. S. SADASIVAN.

Mr. Tompkins Learns the Facts of Life. By G. Gamow (Cambridge University Press), 1953. Pp. xi + 88. Price 12 sh. 6 d.

It was a delightful idea of Professor Gamow to have presented us with another instalment of the adventures of Mr. Tompkins, not among quanta and atoms this time, but in the regions of the stuff that he is made of.

As in the previous volume, there are three dreams and a lecture by the Professor. In the first dream, "Through the blood-stream", Mr. Tompkins finds himself injected into his own body and travels extensively through his tissues, meeting erythrocytes, phagocytes, bacteria, anti-bodies, hormones and vitamins, and suddenly wakes up suffering from an attack "by a flock of hungry trypsins, amylases and lipases". The second dream, "Gene's Piece of Mind" introduces Mr. Tompkins to chromosomes and genes, and the processes of cell division and growth. The third dream on "Brainy Stuff" is by far the most entertaining. Mr. Tompkins meets the calculating machine, "The Maniac" and has an interesting discussion with him, learning much about the way the brain functions.

One cannot but admire the lucidity with which the author writes and more so, the aptness of his examples and the fine sense of humour that pervades the whole book. For

instance, regarding Lysenko's theory, Mr. Tompkins is told, "Western geneticists do not take it seriously, but as a matter of fact, there are many cases in which Lysenko is undoubtedly right. Thus, for example, if Mrs. P gives birth to a baby who looks like her husband, Mr. P, we speak about gene-heredity. But if Mrs. P's baby looks more like Mr. S, a neighbour next door, the effect must be certainly ascribed to the environment."

We do hope that Mr. Tompkins is not too tired and that he would set out very soon on another of his trips, may we suggest, through the maze of the *psyche* and all that it stands for.

Selected Chapters from Modern Inorganic Chemistry. Second Edition. By K. K. Dole. (Dastane Brothers' Home Service, Ltd., Poona), 1953. Price Rs. 13-12-0.

The title of the book does not convey an accurate idea of the scope of the contents. The topics chosen are obviously intended to cater to the needs of students appearing in examinations up to B.Sc. Hons. or M.Sc. (Previous) standard in General Chemistry, but not in specialised Inorganic Chemistry. In a book produced in April 1953 ("revised and enlarged") one would expect up-to-date information and deletion of obsolete "chemical facts". This however is not the case. For example, the compounds of argon and boron fluoride mentioned on page 79 are not now accepted as "chemical facts" after the work of Wiberg and Karbe (1948). On the other hand, no mention is made of "clathrate compounds" discovered by Powell (1948). The chemistry of selenium and tellurium (pp. 531-38), as treated in this book, is very meagre. That interesting compound telluric acid is not even mentioned, much less discussed with reference to its constitution. The treatment of transuranic elements in general, and of neptunium and plutonium in particular, gives the impression that they occur and are available like any other ordinary metal; their chemistry is discussed and even the metallurgy, without mentioning how these remarkable elements are produced (p. 481). Similarly, the method of thermal analysis in the investigation of alloys and intermetallic compounds discussed in pp. 560-61 does not bear critical examination. The curve in Fig. 26 has a second inflexion due to the separation of the eutectic, which is not clarified. The relation between Figs. 26 and 27 has also not been brought out.

The discussion of the Periodic Table could have been cut down to the minimum on the

historical side and the space so saved utilised for a more modern treatment. In this chapter a number of modified tables have been reproduced with however one significant omission, that is, Bohr's modification. To the author the position of hydrogen is still a puzzle: "Many questions in regard to the Periodic Table are still without a final answer and two of these are, (1) the position of hydrogen, and (2) the distribution of the rare-earths of both the Lanthanide and the Actinide series. One has to wait and see how these are tackled and finally solved" (p. 51). One thought that these very questions had been satisfactorily solved in Bohr's Table.

The reference to the National Electrochemical Institute at Karaikudi in the body of the text on p. 434 reveals a lack of sense of proportion especially after its more prominent mention in the preface. Similarly there is an uncritical statement regarding the discovery of atomic nitrogen (p. 130) for which the authority should have been quoted, say, in a foot-note.

There is no purpose served by further critically examining each chapter. The aim of the author being to supply "tabloid" answers for certain specified types of questions, one can obtain only a superficial knowledge of the subject by reading this book. The topics chosen however, are those frequently found in examination papers, and to that extent the book may be useful and even popular; but it requires a good amount of supplementing and corrective reading.

Organic Analysis. Vol. I. Edited by J. Mitchell, Jr., I. M. Kolthoff, E. S. Proskaner and A. Weissberger. (Interscience Publishers.) Pp. viii + 473. Price \$8.50.

The volume under review is the first to be published in a series designed to deal with organic quantitative group analysis. It presents methods for the chemical determinations of hydroxy, alkoxy, α -epoxy, active hydrogen, carbonyl, acetal and organic sulphur groups and spectroscopic functional group analysis in the petroleum industry. Other group determinations and other branches of organic group analysis are to be considered in subsequent volumes.

The book is comprehensive in nature and each chapter is written by a worker who has himself contributed to the development of the particular field under discussion. The various chapters deal mainly with chemical methods of determination, though mention is made of instrumental and chromatographic methods, where available. A

critical evaluation of all available methods has been made and the methods which have been recommended are given in detail. Sources of error are referred to and ways to minimise or eliminate them described. Details for the preparation and standardisation, when required, of reagent solutions are given together with the necessary instructions for storing and handling them.

The book is well documented with references to the original literature upto 1952 and should serve as an excellent source of information in the field of organic group determinations.

S. SWAMINATHAN.

Books Received

Inorganic Synthesis, Vol. IV. Edited by John C. Bailar, Jr. (McGraw-Hill Book Co.), 1953. Pp. xii + 218. Price \$ 5.00.

Radio Receiver Design, Part I. Second Edition. By K. R. Sturley. (Chapman & Hall), 1953. Pp. xx + 667. Price 56 sh.

Structure Reports, Vol. X. By A. J. C. Wilson. (A. Oosthoek Publishing Co., Utrecht, Holland), 1953. Pp. viii + 325. Price D. fl. 45.

Fiber Microscopy. By A. N. J. Heyn. (Interscience Publishers, Inc.), 1954. Pp. xiii + 407. Price \$ 5.50.

High Altitude Rocket Research. By H. E. Newell, Jr. (Academic Press, Inc.), 1953. Pp. xiv + 298. Price \$ 7.50.

Union Catalogue of Learned Periodical Publications in South Asia Physical and Biological Sciences. (Indian Library Association). (G. Glunt & Sons), 1953. Pp. 390. Price Rs. 25.

Low Frequency Amplification. By N. A. J. Voorhoeve. (Philips' Technical Library), 1953. Pp. xv + 495. [Available from Philips Electrical Co. (India), Ltd., Calcutta-20.] Price 24 sh. 4 d.

Select Methods of Metallurgical Analysis. Second Edition. By W. A. Naish, J. E. Clennel and V. S. Kingswood. (Chapman & Hall), 1953. Pp. xii + 660. Price 75 sh. net.

A Systematic Catalogue of the Main Identified Entomological Collection at the Forest Research Institute, Dehra Dun. Indian Forest Leaflet No. 121 (Part III). Published by the Manager of Publications. Pp. 39-187. Price Rs. 4.

Chromatography. By Edgar Lederer and Michael Lederer. (Elsevier Publishing Co.), 1953. Pp. xviii + 460. Price 60 sh.

Neutron Optics. By D. J. Hughes. (Interscience Publishers), 1954. Pp. vii + 136. Price \$ 2.50.

CWIR Research Station, Poona, Annual Report (Technical), 1950. Research Publication No. 16. (The Manager of Publications, Delhi), 1953. Pp. vi + 100 + vi. Price not given.

The Charnockite Problem. By C. S. Pichamuthu. (Mysore Geologists' Association, Bangalore, India), 1953. Pp. 178. Price Rs. 5.

SCIENCE NOTES AND NEWS

University of Madras Lectureships, 1954-55

The Syndicate will proceed shortly to select persons to deliver lectures under the following endowments for the year 1954-55. Applications for lectureships will be received by the Registrar, University of Madras, not later than the 31st March 1954.

(1) *The Maharaja of Travancore Curzon Lectureships* (3).—Three lectures of the value of Rs. 250 each relating to (a) Medicine, Clinical, (b) Engineering, and (c) Agriculture.

(2) *The Dr. Elizabeth Matthai Lectureship* (Value Rs. 300).—A course of not less than three lectures to be delivered on a subject embodying the results of original investigations in some branch of Medicine and Surgery, preference being given to a subject having special reference to the requirements of women and children.

(3) *The Dr. Sir A. Lakshmanaswami Mudaliyar Lectureship* (Value Rs. 500).—A course of not less than three lectures on any subject pertaining to Medicine in any of the various departments including Medical, Education, Medical Relief and Public Health and History of Medicine.

(4) *The Dr. Todla Ekambaram Lectureship* (Value Rs. 200).—A course of not less than two lectures to be delivered on a subject in Botany with special reference to Plant Physiology.

Institution of Chemists (India) Associateship Examination, 1954

The Fourth Associateship Examination of the Institution of Chemists (India) will be held in November 1954. The last date for receiving applications from intending candidates is 31st

July 1954. The examination in Group A (Analytical Chemistry) is divided into the following nine sections and the candidate will be examined in any two of them according to his choice, in addition to General Chemistry including Organic, Inorganic, Physical and Applied Analytical Chemistry: (1) Analysis of Minerals, Silicates, Ores and Alloys, (2) Analysis of Drugs and Pharmaceuticals, (3) Analysis of Foods, (4) Analysis of Water and Sewage, (5) Biochemical Analysis, (6) Analysis of Oils, Fats and Soaps, (7) Fuel and Gas Analysis, (8) Analysis of Soils and Fertilisers, and (9) Analysis connected with Forensic Chemistry.

Further enquiries may be made to the Honorary Secretaries, Institution of Chemists (India), Chemical Department, Medical College, Calcutta-12.

Symposium on Electro-Chemical Processes and Their Application to Indian Industry

The Symposium will be held in the Central Electro-Chemical Research Institute, Karai-kudi, during March 27-28, 1954. It will be inaugurated by Dr. S. S. Bhatnagar.

Conference on the Physics of Particle Size Analysis

At the Institute of Physics' Conference on "The Physics of Particle Size Analysis", to be held in Nottingham from 6th to 9th April 1954, the following sessions have been arranged: the motion of particles in fluids; the scattering of light by particles; the general phenomena encountered in particles size analysis; the comparison of methods and the automatised methods of particle counting and sizing. Further particulars may be obtained from the Secretary, The Institute of Physics, 47, Belgrave Square, London, S.W. 1.

Prof. N. F. Mott

Prof. N. F. Mott, Henry Overton Wills Professor of Physics, and Director of the Henry Herbert Wills Physical Laboratories at Bristol University, is to succeed Sir Lawrence Bragg, who for the past 15 years has occupied the Cavendish Chair of Experimental Physics at Cambridge University.

Underground Laboratory for Cosmic Ray Research

An Australian laboratory for atomic research is to be constructed 50 feet underground at the University of Sydney, New South Wales. Investigators will study the action of mesons, and of the hard components of cosmic rays. The 50 feet of earth above will filter out the protons and electrons, but will not stop the mesons, the depth of whose penetration is not yet known.

The passage of the mesons will be recorded on specially prepared photographic plates, and by means of a cloud chamber. A six-ton electro magnet around the cloud chamber will be used to measure the charge and energy of the mesons.

Studies at the Weizmann Institute

Exploitation of solar energy, of which Israel has an abundance, forms an important part of researches carried on at the Weizmann Institute in Israel. Special study is being devoted to the production of animal fodder through controlled photosynthesis. Underground water resources are also being explored by the Institute's Isotope Research Department. Through radio-activity tests, it can be determined whether underground water is flowing, or is merely a reservoir with no water sources supplying it. This is very important in areas such as the Negev desert region, where cultivators using subterranean water need to know whether it will be exhausted after a certain period of time.

Award of Research Degree

The Andhra University has awarded the D.Sc. Degree in Geology to Mr. N. Sathapathi for his thesis entitled, "Petrology and Petrogenesis of Nepheline Syenites and Associated Rocks of Koraput (Orissa)".

The Andhra University has awarded the Ph.D. Degree in Mathematics to Mr. B. Viswanatham for his thesis entitled, "Contribution to the Theory of Differential Equations".

The University of Bombay has awarded the Degree of Ph.D. in Chemistry to Mr. T. C. Appanna, for his thesis entitled 'Studies in Prawns and Fish Liver Oils'.

The University of Poona has awarded the Ph.D. Degree in Archaeology to Shri Ramachandra Vinayak Joshi for his thesis entitled 'Pleistocene Studies of the Malaprabha Basin'.